

QUATERNARY OSTRACODS FROM THE CONTINENTAL MARGIN OFF SOUTH-WESTERN AFRICA PART I. DOMINANT TAXA

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(With 59 figures and 6 tables)

[MS accepted 28 February 1990]

ABSTRACT

Eighteen species belonging to eleven genera account for 87 per cent of the total fauna of benthic ostracods from the continental shelf and upper slope between the Kunene River and Cape Peninsula. Seven new species, one new subspecies and a new genus are described. These are: *Cytherella namibensis*, *Palmoconcha? walvisridgensis*, *Kuiperiana angulata*, *Neocytherideis boomeri*, *Ambostracon* (A.) *keeleri*, *Paracypris lacrimata*, and *Xestoleberis hartmanni*; *Bensonina knysnaensis robusta*; and *Pseudokeijella*. Eleven of the species have been previously recorded from the area. The remaining 14 per cent of the total ostracod fauna, none of which occur as dominants, will be described in Part II of this report.

The faunas have been subdivided into 'modern' and 'relict' assemblages and, on a regional scale, the dominant taxonomic groupings in both assemblages are the same. The shelf north of Walvis Bay has a loxoconchid-*Cytherella*-*Bensonina* fauna, whereas south of the Orange River a *Ruggieria cytheropteroides*-*Pseudokeijella lepralioides* fauna occurs. The intervening area has a mixed assemblage.

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INTRODUCTION

Sea-floor sediment samples from the continental shelf and upper slope (<950 m water depth) off south-western Africa have been investigated for their benthic ostracod fauna. Of the 269 samples examined, 192 contained ostracod valves, whereas 77 were barren (Fig. 1). Details of these faunas will be presented in three parts: Part I (present report) deals with the dominant taxa, Part II (in press) deals with those species that occur as minor constituents of the fauna, and Part III (in preparation) is a discussion of the ecology of the ostracod populations and palaeo-oceanographic implications. Earlier publications have dealt with the fauna from a further 45 sediment samples collected in water depths >950 m (Dingle *et al.* 1989, 1990).

The continental shelf off south-western Africa extends latitudinally from 17°S to 35°S, a distance of nearly 2 000 km. To the north, surface waters are affected by the

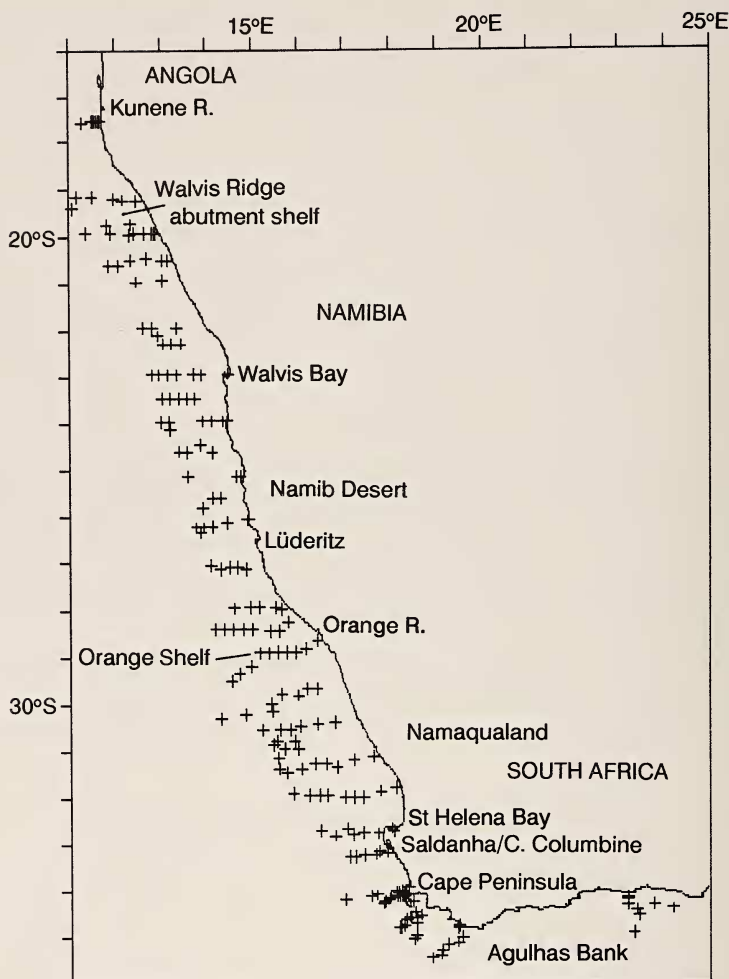


Fig. 1. Ostracod-bearing samples from water depths less than 950 m along the continental margin off south-western Africa. Those on the eastern Agulhas Bank were reported on by Keeler (1981).

subtropical Angola Current, whereas most of the region lies under the influence of the northward flowing Benguela System, which is subject to intense upwelling in quasi-permanent zones (Lutjeharms & Meeuwis 1987). This phenomenon gives rise locally to steep water-temperature, salinity, and dissolved-oxygen gradients, as well as strongly influencing local substrates. Much of the area lies adjacent to an arid hinterland with low and episodic fluvial runoff. The extreme southern part of the region is periodically influenced by inflow of subtropical Agulhas Current water from across and around the Agulhas Bank. A more detailed discussion of the oceanography and substrates will be given in Part III.

Modern marine Ostracoda were first reported from this region by Brady (1880), who identified 14 species of podocopid Ostracoda from two samples collected in 1873

during the 1873–76 HMS 'Challenger' expedition: Station 140 (15–20 fm) (27–37 m): False Bay) and Station 142 (150 fm (274 m): off the Cape of Good Hope). Brady's 'Challenger' collection (including types of the South African species; see Table 1) was re-illustrated, and lectotypes established by Puri & Hulings (1976). Subsequently, several authors have worked on ostracod collections taken mostly from coastal sites (Table 1): Müller (1908) reported on the fauna from one sample in Simonstown Harbour (in the course of describing material collected on the German South Polar Expedition 1901–03); Klie (1940) reported on ostracods from the vicinity of Lüderitz and Swakopmund; Benson & Maddocks (1964) described the fauna from Knysna Lagoon (and illustrated a specimen from False Bay); and Whatley & Dingle (1989) reported from the margin off south-western Africa the first known sighted species of the genus *Poseidonamicus*. Also, in a major regional survey, Hartmann (1974) recorded faunas from numerous localities on the coast between northern Angola and Mozambique.

Unpublished theses dealing with modern marine ostracods from the area have been produced by Keeler (1981—eastern Agulhas Bank) and Boomer (1985—continental margin, south-western Africa). Both these studies used samples collected by the Marine Geoscience Unit at the University of Cape Town.

Tankard (1976), in his account of the Pleistocene deposits of the coastal plain between Saldanha Bay and Elands Bay (Cape Deseada), identified 18 species of marine Ostracoda, 13 of which he was able to refer to previously described taxa (Table 1).

TABLE 1
Previous records of ostracods from south-western and southern Africa".

	Walvis Bay*	Lüderitz	Saldanha area	Cape Pen.	False Bay	Knysna Lagoon
BRADY 1880						
<i>Pontocypris subreniformis</i> sp. nov.					x	
<i>Macrocypris maculata</i> Brady					x	
<i>Bairdia ovata</i> Bosquet					x	
<i>Cythere exilis</i> sp. nov.					x	
<i>Cythere flabellcostata</i> sp. nov.					x	
<i>Cythere lepralioides</i> sp. nov.				x	x	
<i>Cythere craticula</i> sp. nov.					x	
<i>Cythere melobesioides</i> Brady				x		
<i>Cythere cytheropteroides</i>				x		
<i>Cythere stolonifera</i>					x	
<i>Loxoconcha subrhomboidea</i> sp. nov.					x	
<i>Xestoleberis africana</i> sp. nov.					x	
<i>Cytherura mucronata</i> sp. nov.					x	
<i>Cytherura clausi</i> sp. nov.					x	
<i>Cytherella dromedaria</i> sp. nov.					x	
MÜLLER 1908						
<i>Macrocypris dispar</i> sp. nov.					x	
<i>Macrocypris africana</i> sp. nov.					x	
<i>Pontocypris gaussi</i> sp. nov.					x	
<i>Pontocypris flava</i> sp. nov.					x	
<i>Xestoleberis capensis</i> sp. nov.					x	
<i>Xestoleberis ramosa</i>					x	

Table 1 (cont.)

	Walvis Bay*	Lüderitz	Saldanha Area	Cape Pen.	False Bay	Knysna Lagoon
KLIE 1940						
<i>Pontocypris flava</i> Müller		x				
<i>Eucythereis mirabilis</i> sp. nov.	x					
<i>Eucythereis levezovi</i> sp. nov.		x				
<i>Procythereis serrata</i> sp. nov.		x				
<i>Procythereis major</i> sp. nov.		x				
<i>Procythereis minor</i> sp. nov.		x				
<i>Xestoleberis ramosa</i> Müller		x				
<i>Xestoleberis crenulata</i> sp. nov.		x				
<i>Xestoleberis ferax</i> sp. nov.		x				
<i>Xestoleberis baja</i> sp. nov.		x				
<i>Xestoleberis humilis</i> sp. nov.		x				
<i>Sclerochilus incurvatus</i> sp. nov.		x				
<i>Sclerochilus meridionalis</i> Müller		x				
<i>Cytherois minor</i> Müller		x				
<i>Paradoxostoma caeruleum</i> sp. nov.		x				
<i>Paradoxostoma griseum</i> sp. nov.		x				
<i>Paradoxostoma angustissimum</i> sp. nov.		x				
<i>Paradoxostoma auritum</i> sp. nov.		x				
<i>Paradoxostoma reflexum</i> sp. nov.		x				
<i>Paradoxostoma semilunare</i> sp. nov.		x				
BENSON & MADDOCKS 1964						
<i>Cytherella</i> aff. <i>punctata</i> Brady						x
<i>Bairdia villosa</i> ? Brady						x
<i>Paracypris westfordensis</i> sp. nov.						x
<i>Aglaiella railbridgensis</i> sp. nov.						x
<i>Perissocytheridea estuaria</i> sp. nov.						x
<i>Sulcostocythere knysnaensis</i> sp. nov.						x
<i>Cytheretta knysnaensis</i> sp. nov.					x	x
<i>Loxoconcha parameridionalis</i> sp. nov.						x
<i>Loxoconcha megapora</i> sp. nov.						x
<i>Xestoleberis capensis</i> Müller						x
<i>Hemicythere</i> ? sp.						x
<i>Nereina</i> ? sp. A						x
<i>Nereina</i> ? sp. B						x
<i>Aurila dayii</i> sp. nov.						x
<i>Urocythereis</i> sp.						x
<i>Mutilus</i> sp.						x
<i>Bradleya</i> ? sp.						x
HARTMANN 1974						
<i>Cytherella</i> aff. <i>punctata</i> Brady						x
<i>Bairdoppilata</i> sp. 44		x				
<i>Perissocytheridea estuaria</i> B & M					x	
<i>Sulcostocythere knysnaensis</i> B & M		x			x	
<i>Cyprideis limbocostata</i> sp. nov.	x					
<i>Cyprideis remanie</i> Klie		x				
<i>Mutilus bensonmaddocksorum</i> sp. nov.		x				x
<i>Aurila kliei</i> sp. nov.		x		x		
<i>Aurila levezovi</i> (Klie)		x				
<i>Aurila petricola</i> sp. nov.		x		x		x
<i>Procythereis major</i> Klie		x				
<i>Procythereis minor</i> Klie		x		x		
<i>Procythereis serrata</i> Klie		x				
<i>Procythereis foveata</i> sp. nov.						x
<i>Caudites knysnaensis</i> sp. nov.						x
<i>Cytheretta knysnaensis</i> B & M						x
<i>Loxoconcha walvisbaiensis</i> sp. nov.	x					
<i>Loxoconcha megarora</i> var. <i>magna</i> n. var.		x				x
<i>Loxoconcha parameridionalis</i> B & M					x	
<i>Australoxochonca favornamentata</i> sp. nov.						x
<i>Australoxochonca parafavornamentata</i> sp. nov.						x
<i>Semicytherura dayi</i> sp. nov.						x
<i>Hemicytherura? kazmaierae</i> sp. nov.		x				

Table 1 (cont.)

	Walvis Bay*	Lüderitz	Saldanha Area	Cape Pen.	False Bay	Knysna Lagoon
TANKARD 1976						
<i>Paracypris westfordensis</i> B & M			x			
<i>Aglaiella railbridgensis</i> B & M			x			
<i>Cytheretta knysnaensis</i> B & M			x			
<i>Cyprideis</i> cf. <i>limbocostata</i> Hartmann			x			
<i>Perissocytheridea estuaria</i> B & M			x			
<i>Cytherura</i> sp.			x			
<i>Hemicytherura parvifossata</i> Hartmann			x			
<i>Bairdia</i> cf. <i>villosa</i> Brady			x			
<i>Aurila dayii</i> B & M			x			
<i>Caudites knysnaensis</i> Hartmann			x			
<i>Procythereis</i> sp.			x			
<i>Urocythereis</i> sp.			x			
<i>Loxoconcha parameriodionalis</i> B & M			x			
<i>Loxoconcha peterseni</i> Hartmann			x			
<i>Cytheromorpha</i> sp.			x			
<i>Bradleya</i> sp.			x			
<i>Xestoleberis capensis</i> Müller			x			
<i>Cytherella punctata</i> Brady			x			

"—excludes Myodocopida

*—includes Swakopmund and Sandwich Harbour

B & M—Benson & Maddocks

Additional relevant studies of modern and late Tertiary ostracod faunas from adjacent areas include the following: Skogsberg (1939—Subantarctic), Benson (1964—Antarctica), Bold (1966—Gabon), Neale (1967—Antarctica), Maddocks (1969, 1977—Southern Ocean), Valicenti (1977—Patagonia), Babinot & Kouyoumontzakakis (1986—Congo estuary), Hartmann (1986, 1987, 1988—Antarctica), Whatley *et al.* (1987, 1988—Antarctic and south-western Atlantic), and Coimbra & Pinto de Ornellas (1989—Brazil).

DOMINANT TAXA

Approximately 120 species have been identified from the continental shelf and upper slope off south-western Africa within a total collection of 24 058 specimens from 192 ostracod-bearing sediment samples. In this paper I discuss the 11 dominant groups (10 genera and one family) that individually account for 2 per cent or more of the total specimen count (Table 3). This is merely a convenience for handling the large data set, but the eighteen species concerned account for 87 per cent of the overall population and give a first order impression of regional taxa dominance. Distribution patterns for the total fauna will be discussed in Part III.

Table 2 lists the locations and faunal contents of the 183 ostracod-bearing sediment samples that contain one or more of the species described in this paper (Table 3). The eleven dominant taxa constitute a mean of 82 per cent of the fauna of each sample but it is notable that, in relation to the depth distribution of the total fauna, these taxa are most important in water depths 60–400 m (mean 86%—Fig. 2). At inshore sites they constitute 74 per cent, and at depths >400 m 66 per cent, although they are relatively more abundant between 800 m and 950 m than in the

TABLE 2
Location of ostracod fauna of sediment samples.

TBD sample no.	Latitude (°S)	Longitude (°E)	Water depth (m)	Total no. of valves	<i>Pseudoejella leptolobus</i>		<i>Ruggieria cytheropteroides</i>		<i>Ambostracon (A.) flabellicosata</i>		<i>Ambostracon (A.) keeleri</i>		<i>Ambostracon (A.) levetzovi</i>		<i>Henryhowella melobesioides</i>		<i>Doracocythere exilis</i>		<i>Neocytherideis boomeri</i>		<i>Palmosconcha walvisbaensis</i>	
					R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M
3509	22,895	14,4916	15	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
6821	34,0597	18,355	15	126	-	-	-	-	-	5	-	2	-	-	-	-	-	-	-	-	-	-
3089	32,6833	18,0833	18	72	-	-	-	-	-	4	-	5	7	11	8	-	-	-	-	-	-	-
3265	26,05	14,9333	31	240	-	-	-	-	-	4	-	1	-	-	-	-	-	-	-	-	5	-
5254	34,2033	18,51	40	574	95	40	-	-	182	29	-	-	-	-	-	-	3	-	2	1	-	-
6822	34,09	18,3333	42	36	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
3087	32,62	18,0417	42	334	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3217	25,1166	14,7466	50	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3264	26,05	14,9	51	59	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	1	-
3011	27,95	15,6366	52	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-
1341	34,74	19,5216	53	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
271	34,45	18,575	55	5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
2224	33,1566	17,955	58	145	-	-	-	-	1	8	3	-	-	-	-	-	-	-	-	-	-	-
3892	17,5333	11,6833	65	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2
3953	19,9166	12,8933	67	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
344	34,7733	19,5083	73	37	-	1	-	-	-	1	3	1	-	-	-	-	-	-	1	-	-	-
3219	25,1166	14,6666	75	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3966	20,45	13,1467	76	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
3469	23,9333	14,355	79	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	2
6836	33,9608	18,2733	80	769	9	187	-	-	13	-	24	-	-	-	-	39	-	62	10	-	-	-
3952	19,9166	12,86	82	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	2
3304	31,0883	17,6467	88	17	11	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3010	27,925	15,5166	88	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6824	34,09	18,2825	90	2020	26	528	-	-	12	-	11	-	-	-	-	71	-	312	5	-	-	-
3951	19,9166	12,8233	92	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
6847	34,0923	18,2717	94	936	14	428	-	4	-	-	-	-	-	-	-	29	-	63	8	-	-	-
6846	34,015	18,264	95	486	2	4	-	-	-	-	15	5	-	-	-	-	-	5	-	-	-	-
6835	34,0267	18,2	100	65	-	-	-	1	3	2	28	9	-	-	3	-	-	-	-	-	-	-
2257	32,7467	17,7617	100	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2991	28,255	15,79	100	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3891	17,5333	11,6416	104	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-
3969	20,45	13,0367	112	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
3890	17,5333	11,6	115	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	4
6823	34,0925	18,215	120	1098	18	10	69	16	6	-	593	9	-	-	3	-	1	-	8	-	-	-
3862	19,9166	12,6416	122	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-
2935	28,8	16,1833	126	18	16	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2344	31,8333	17,8083	128	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3889	17,5333	11,5666	130	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
270	34,5167	18,6833	131	1460	478	700	22	-	26	1	50	-	-	-	2	-	2	-	1	-	-	-
346	34,97	19,6	133	15	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2970	28,4333	15,6	135	305	241	13	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3519	22,9333	13,8883	138	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3927	19,21	12,1766	139	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
3829	20,9166	13,0366	140	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	8
3587	33,995	18,1483	140	167	2	-	45	4	1	-	43	1	-	-	6	-	-	-	-	-	-	-
3520	22,9266	13,7133	142	54	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	38	7
3007	27,93	15,1583	147	12	2	2	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2928	28,8666	15,9666	149	94	87	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3863	19,9166	12,4333	150	189	2	-	100	26	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2337	31,95	17,4333	153	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
341	35,08	19,5083	153	9	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3888	17,5333	11,5333	154	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3414	24,6	14,1333	154	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
2222	33,135	17,7766	155	5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2924	28,9	15,1666	158	76	24	8	18	2	1	-	3	-	-	-	-	10	-	2	-	-	-	-
6825	34,09	18,1733	160	222	68	-	33	2	5	-	24	-	-	-	7	-	20	-	1	-	-	-
3786	21,9166	13,3583	160	24	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	3	-
3467	23,93	14,1066	161	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	1
3559	23,43	13,7567	162	83	10	-	-	-	14	-	18	-	-	-	-	-	-	-	-	-	27	1
2971	28,4333	15,4	162	1095	949	2	46	-	30	-	8	-	-	-	-	-	-	-	-	-	-	-
2861	29,6333	16,4167	165	13	10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3887	17,5333	11,5	167	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3770	22,25	13,45	169	37	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	16	1
2860	29,6333	16,2167	170	135	84	-	14	-	-	-	4	-	-	-	-	7	-	-	-	-	-	-
2752	29,7833	16,0167	170	374	145	-	68	-	26	-	21	-	-	-	-	43	-	-	-	-	-	-

<i>Kuiperiana</i> <i>angulata</i>		<i>Palmoconcha?</i> <i>walvisdringensis</i>		<i>Palmoconcha</i> <i>subrhomboida</i>		<i>Cytherella</i> <i>namibensis</i>		<i>Cytherella</i> <i>dromedaria</i>		<i>Paracypris</i> <i>lacrimata</i>		<i>Bensonina</i> <i>knysnaensis</i>		<i>Bensonina</i> <i>knysnaensis</i> <i>robusta</i>		<i>Xestoleberis</i> <i>africana</i>		<i>Xestoleberis</i> <i>hartmanni</i>		Total Relict	Total Modern	Subtotal	% Total
R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M				
-	-	-	-	-	-	-	-	-	-	1	1	1	48	-	-	-	-	-	2	0	5	5	100
-	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	-	-	-	-	2	58	60	47
-	-	-	-	-	-	-	-	-	-	-	-	214	10	-	-	-	-	-	-	24	20	44	61
-	-	-	-	21	14	-	-	39	1	1	8	7	4	-	-	43	3	-	-	224	10	234	97
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	394	95	489	85
-	-	-	-	-	-	-	-	-	-	-	-	292	42	-	-	-	-	1	-	1	6	7	19
-	-	-	-	-	-	-	-	-	-	-	-	79	21	-	-	-	-	-	-	292	42	334	100
-	-	-	-	-	-	-	-	-	-	-	-	46	1	-	-	-	-	-	-	55	1	56	94
-	-	-	-	-	-	-	-	-	-	-	-	6	5	-	-	-	-	-	-	14	5	19	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1	20
-	-	-	-	-	-	-	-	-	-	-	-	33	92	-	-	-	-	-	-	37	100	137	94
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	7	87
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	15	40
-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	13	0	13	86
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	2	90	100
-	-	-	-	-	-	-	-	85	-	114	9	17	2	-	-	51	17	-	-	414	225	639	83
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	2	27	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	6	17	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1036	609	1645	81
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	100
-	-	-	-	2	-	-	-	372	-	10	1	166	74	-	-	54	1	-	-	389	476	865	92
-	-	-	-	-	2	-	-	180	6	9	-	5	1	-	-	89	27	-	-	222	67	289	59
-	-	-	-	-	-	-	-	2	-	151	42	-	-	-	-	47	16	-	-	38	12	50	76
-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	4	-	-	-	3	1	4	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	0	16	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	4	100
-	-	-	-	-	-	5	1	-	-	-	-	-	-	-	-	-	-	-	-	25	5	30	96
-	-	-	-	-	13	-	2	-	98	-	-	-	-	-	-	26	-	-	-	837	35	872	79
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	2	18	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	100
2	-	-	-	-	-	1	-	2	-	7	-	-	-	-	-	51	-	-	-	643	701	1344	92
-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	4	4	8	53
-	-	-	-	-	-	5	5	-	-	-	-	-	-	-	-	-	-	-	-	285	18	303	99
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	100
-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	3	5	100
-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	13	8	21	100
1	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	4	-	-	-	110	5	115	68
-	-	-	-	-	-	6	-	-	-	-	-	-	-	1	-	-	-	-	-	47	7	54	100
-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3	10	83
1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	94	0	94	100
-	-	-	-	-	-	36	-	-	-	-	-	-	-	-	-	-	-	-	-	139	27	166	87
-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	4	44
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	2	2	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3	60
2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	12	72	94
-	-	-	-	-	-	-	-	-	-	2	-	3	-	-	-	2	-	13	-	178	2	180	81
1	-	-	-	-	-	5	-	-	-	-	-	-	-	10	-	-	-	-	-	22	0	22	91
-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	19	1	20	100
-	-	-	-	-	-	6	-	-	-	-	-	-	-	4	-	-	-	-	-	79	1	80	96
-	-	-	-	-	-	3	1	-	-	2	-	41	-	-	-	2	-	-	-	1081	3	1084	98
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0	11	84
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	34	1	35	94
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	113	0	113	83
-	-	-	-	-	-	-	-	-	-	5	-	2	-	-	-	3	-	-	-	313	0	313	83

<i>Kuiperiana</i> <i>angulata</i>		<i>Palmacantha?</i> <i>walvisbergensis</i>		<i>Palmacantha</i> <i>sternomoides</i>		<i>Cytherella</i> <i>namibensis</i>		<i>Cytherella</i> <i>dromedaria</i>		<i>Paracypris</i> <i>lacrimata</i>		<i>Bensonella</i> <i>krysaensis</i> <i>krysaensis</i>		<i>Bensonella</i> <i>krysaensis</i> <i>robusta</i>		<i>Xestoleberis</i> <i>africana</i>		<i>Xestoleberis</i> <i>harmanni</i>		Total Relict	Total Modern	Subtotal	% Total
R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M				
3	-	-	-	-	-	3	-	2	-	1	-	1	-	-	-	9	-	-	-	868	6	874	93
11	1	-	-	-	-	-	-	-	-	-	-	12	-	-	-	14	-	-	-	114	0	114	91
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1318	11	1329	91
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	12
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	0	9	75
11	2	-	-	-	-	14	-	-	-	6	-	-	-	-	-	-	-	-	-	7	0	7	100
-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	1	-	-	-	714	29	743	83
-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	70	0	70	97
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	21	14	35	83
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	266	2	268	94
-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	20	9	29	93
14	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	1	-	-	-	368	0	368	92
-	-	-	-	-	-	3	-	-	-	-	-	20	-	-	-	14	-	-	-	1954	6	1960	97
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0	10	76
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	60	0	60	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1	8	72
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	687	3	690	92
-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	1	44	93
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	2	-	-	-	23	-	-	-	-	-	-	-	13	-	-	-	-	-	205	2	207	95
-	-	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	125	1	126	96
-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	250	11	261	81
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	7	100
-	1	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	7	-	-	-	496	3	499	89
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	48	9	57	52
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0	7	87
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	0	92	82
-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	211	1	212	88
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	494	0	494	95
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	24	0	24	61
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	29	70	94
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	4	100
-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	83	5	88	77
-	-	-	-	-	-	10	6	-	-	-	-	9	1	-	-	-	-	-	-	6	0	6	75
-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	45	20	65	98
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	88
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	105	0	105	75
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	31	1	32	45
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	143	0	143	89
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0	2	66
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	41	0	41	95
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	116	1	117	85
-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	33	0	33	84
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	100
-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	7	0	7	87
-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0	8	100
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	9	0	9	90
-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0	2	28
-	-	-	-	-	-	49	6	-	-	-	-	-	-	-	-	1	-	-	-	7	1	8	61
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	25	130	85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0	6	85
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	2	100
-	-	-	-	-	-	3	-	1	-	6	-	-	-	-	-	-	-	-	-	278	2	280	93
-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	8	0	8	47
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	1	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	4	41	100
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	8	0	8	88
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	31	0	31	79
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	4	0	4	50

Table 2 (cont.)

TBD sample no.	Latitude (°S)	Longitude (°E)	Water depth (m)	Total no. of valves	<i>Pseudokeijella lepralioides</i>		<i>Ruggieria cytheropteroides</i>		<i>Ambostracon (A.) flabellcostata</i>		<i>Ambostracon (A.) keeleri</i>		<i>Ambostracon (A.) lewizovi</i>		<i>Henryhowella melobesioides</i>		<i>Doratocythere exilis</i>		<i>Neocytherideis boomeri</i>		<i>Palmosconcha pulchritarsis</i>	
					R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M
4015	22.0833	12.9333	325	10	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3789	21.9	12.8166	325	8	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3522	22.9333	13.345	344	44	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2470	30.755	15.55	345	59	-	-	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3866	19.9166	11.9133	348	7	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3171	27.0833	14.5167	349	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2447	31.925	16.4666	350	49	-	-	24	1	-	-	-	-	-	-	8	-	-	-	-	-	-	-
2976	28.4167	14.3833	350	18	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
3256	26.2166	13.95	352	7	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3923	19.1566	11.5	368	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3943	19.7333	11.8167	373	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2825	34.1	17.6	375	8	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
3556	23.4333	13.2167	379	31	-	-	7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3826	20.9333	12.4666	382	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3359	26.325	13.875	385	12	-	-	8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3255	26.2166	13.7833	390	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3562	24.6067	13.5833	391	69	-	-	20	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2448	31.925	16.255	392	37	-	-	20	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
3172	27.1167	14.3	403	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1694	34.75	18.3267	425	31	1	-	1	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-
3462	23.9583	13.1916	430	40	-	-	13	2	-	-	-	-	-	-	40	-	-	-	-	-	-	-
2488	30.8416	15.4666	430	14	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3179	27.0333	14.1	437	79	-	-	49	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2262	32.7917	16.8167	450	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2440	33.2416	17.15	450	18	-	-	1	-	-	-	-	-	-	-	8	1	-	-	-	-	-	-
3577	31.3667	16.0833	453	96	-	-	35	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
2700	30.2167	14.85	469	13	-	-	5	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
2780	33.2416	17.25	475	42	-	-	20	1	-	-	-	-	-	-	6	1	-	-	-	-	-	-
3524	22.9333	12.9666	475	64	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
301	35.0333	18.5333	500	7	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
1698	34.7833	18.2167	502	10	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-
3225	25.1166	13.6	530	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2879	29.4833	14.55	530	61	-	-	3	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
1697	34.7667	18.25	545	112	-	-	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-	-
2785	33.225	17.45	560	12	-	-	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
3845	20.5917	12.0833	566	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3555	23.4433	13.03	590	19	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3112	31.45	15.7667	648	11	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
3561	24.58	13.4167	655	9	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
3458	24.1	13.2	725	16	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-
3346	31.12	15.575	730	23	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-
2978	28.4	14.2	736	38	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
3921	19.1366	11.1666	738	4	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
3885	17.5666	11.2833	779	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3846	20.5833	11.8667	810	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
3869	19.9167	11.3667	825	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
3113	31.3667	15.5833	840	16	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-
3525	22.9333	12.8	850	14	-	-	-	-	-	-	-	-	-	-	10	2	-	-	-	-	-	-
3461	23.9583	13.0166	850	13	-	-	-	-	-	-	-	-	-	-	7	2	-	-	-	-	-	-
3109	31.9	15.9	900	80	-	-	-	-	-	-	-	-	-	-	41	1	-	-	-	-	-	-
2697	30.2833	14.3167	940	12	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
3704	19.3666	11.06	941	16	-	-	-	-	-	-	-	-	-	-	14	2	-	-	-	-	-	-
3341	32.6833	16.5167	945	36	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-
Total valves				24059	6235	1946	5266	223	442	48	989	35	11	8	415	14	637	0	486	25	414	6
% Relict					34.5	-	29.1	-	2.4	-	5.4	-	0.0	-	2.2	-	3.5	-	2.6	-	2.2	-
% Modern					-	68.0	-	7.7	-	1.6	-	1.2	-	0.2	-	0.4	-	0	-	0.8	-	2
% Subtotal					39.1	-	26.2	-	2.3	-	4.8	-	0.0	-	2.0	-	3.0	-	2.4	-	2.2	-
% Total ostracod fauna					33.8	-	22.7	-	2.0	-	4.2	-	0.0	-	1.7	-	2.6	-	2.1	-	1.9	-

Abbreviations: R = relict fauna, M = modern fauna

<i>Kuiperiana</i> <i>angulata</i>	<i>Palmococoncha?</i> <i>walvisrugensis</i>	<i>Palmococoncha</i> <i>subrhomboidalea</i>	<i>Cytherella</i> <i>namibensis</i>	<i>Cytherella</i> <i>dromedaria</i>	<i>Paracypris</i> <i>lacrimata</i>	<i>Bensonella</i> <i>krystaensis</i>	<i>Bensonella</i> <i>krystaensis</i> <i>robusta</i>	<i>Xestoleberis</i> <i>africana</i>	<i>Xestoleberis</i> <i>harmanni</i>	Total Relict	Total Modern	Subtotal	% Total										
M	R	M	R	M	R	M	R	M	R	M	R	M	% Total										
-	-	-	6	-	-	-	-	-	-	10	0	10	100										
-	-	-	2	-	-	-	-	-	-	5	0	5	62										
-	-	-	10	-	-	-	-	-	-	43	0	43	97										
-	-	-	1	-	-	-	-	-	-	53	0	53	89										
-	-	-	6	-	-	-	-	-	-	7	0	7	100										
-	-	-	-	-	4	-	-	-	-	4	0	4	100										
-	-	-	-	-	1	-	-	-	-	33	1	34	69										
-	-	-	-	-	6	-	-	-	-	10	1	11	61										
-	-	-	1	-	-	-	-	-	-	7	0	7	100										
-	-	-	5	-	-	-	-	-	-	6	0	6	75										
-	-	-	8	-	2	-	-	-	-	10	0	10	100										
-	-	-	-	-	-	-	-	-	-	8	0	8	100										
-	-	-	14	-	2	-	-	-	-	23	2	25	80										
-	-	-	22	-	-	-	-	-	-	22	0	22	95										
-	-	-	-	-	-	-	-	-	-	8	2	10	83										
-	-	-	-	-	-	-	-	-	-	1	0	1	100										
-	-	-	32	-	1	-	-	-	-	53	6	59	85										
-	-	-	1	-	1	-	-	-	-	29	0	29	78										
-	-	-	-	-	-	-	-	-	-	3	0	3	100										
-	-	-	13	-	-	-	-	-	-	21	0	21	67										
-	-	-	2	-	-	-	-	-	-	28	2	30	75										
-	-	-	-	-	-	-	-	-	-	1	0	1	7,1										
-	-	-	-	-	1	-	-	-	-	51	3	54	68										
-	-	-	-	-	3	-	-	-	-	1	0	1	33										
-	-	-	-	-	-	-	-	-	-	12	1	13	72										
-	-	-	1	-	-	-	-	-	-	36	0	36	37										
-	-	-	43	-	-	-	-	-	-	6	3	9	69										
-	-	-	-	-	-	-	-	-	-	27	2	29	69										
-	-	-	-	-	-	-	-	-	-	49	2	51	79										
-	-	-	-	-	-	-	-	-	-	6	0	6	85										
-	-	-	-	-	1	-	-	-	-	6	0	6	60										
-	-	-	1	-	-	-	-	-	-	1	0	1	100										
-	-	-	3	-	-	-	-	-	-	7	2	9	14										
-	-	-	-	-	-	-	-	1	3	23	0	23	20										
-	-	-	1	-	-	-	-	-	-	8	0	8	66										
-	-	-	6	-	3	-	-	-	-	1	0	1	100										
-	-	-	-	-	-	-	-	-	-	11	0	11	57										
-	-	-	-	-	-	-	-	-	-	10	0	10	90										
-	-	-	-	-	-	-	-	-	-	9	0	9	100										
-	-	-	-	-	-	-	-	-	-	5	2	7	43										
-	-	-	2	-	-	-	-	-	-	13	0	13	56										
-	-	-	-	-	-	-	-	-	-	12	0	12	31										
-	-	-	-	-	-	-	-	-	-	1	1	2	50										
-	-	-	-	-	-	-	-	-	-	2	0	2	20										
-	-	-	-	-	-	-	-	-	-	1	0	1	100										
-	-	-	-	-	1	-	-	-	-	1	0	1	100										
-	-	-	-	-	-	-	-	-	-	12	0	12	75										
-	-	-	-	-	-	-	-	-	-	11	2	13	92										
-	-	-	-	-	-	-	-	-	-	8	2	10	76										
-	-	-	-	-	-	-	-	-	-	41	1	42	52										
-	-	-	-	-	-	-	-	-	-	9	0	9	75										
-	-	-	-	-	1	-	-	-	-	14	2	16	100										
-	-	-	-	-	-	-	-	-	-	24	0	24	66										
7	3	2	23	16	396	27	695	7	490	57	-	993	318	43	0	436	64	18	2	18046	2861	20907	87
0,2	0,0	0,0	0,1	0,5	2,1	0,9	3,8	0,2	2,7	-	-	5,5	11,1	0,2	-	2,4	-	0,0	-	-	-	-	-
-	0,0	-	0,1	-	2,0	-	3,3	-	2,6	-	-	6,2	-	0,2	-	2,3	-	0,0	-	-	-	-	-
-	0,0	-	0,1	-	1,7	-	2,9	-	2,2	-	-	5,4	-	0,1	-	2,0	-	0,0	-	-	-	-	-



11

[illegible]

Abbreviations: R = relict fauna, M = modern fauna

TABLE 3

Taxa described in this paper, and their abundance as a percentage of the fauna of the 183 samples in which they occur.

	Percentage of fauna		
	Total	Modern	Relict
<i>Pseudokeijella lepralioides</i> (Brady)	39,0	67,9	34,5
<i>Ruggieria cytheropteroides</i> (Brady)	26,2	7,7	29,1
<i>Bensoni</i> sp.	6,4	11,1	5,6
<i>Bensoni knysnaensis knysnaensis</i> (Benson & Maddocks)	6,2	11,1	5,4
<i>Bensoni knysnaensis robusta</i> subsp. nov.	0,2	0	0,2
<i>Ambostracon</i> spp.	7,2	3,0	7,9
<i>Ambostracon keeleri</i> sp. nov.	4,8	1,6	5,4
<i>Ambostracon flabellcostata</i> (Brady)	2,3	1,2	2,4
<i>Ambostracon levezovi</i> (Klie)	0,1	0,4	0,1
<i>Henryhowella melobesioides</i> (Brady)	2,0	0,4	2,2
<i>Cytherella</i> spp.	5,3	1,1	5,9
<i>Cytherella dromedaria</i> Brady	3,3	0,2	3,8
<i>Cytherella namibensis</i> sp. nov.	2,0	0,9	2,1
<i>Paracypris lacrimata</i> sp. nov.	2,6	1,9	2,7
<i>Doratocythere exilis</i> (Brady)	3,0	0	3,5
<i>Neocythereis boomeri</i> sp. nov.	2,4	0,9	2,6
<i>Xestoleberis</i> spp.	2,4	2,3	2,4
<i>Xestoleberis africana</i> Brady	2,3	2,2	2,4
<i>Xestoleberis hartmanni</i> sp. nov.	0,1	0,1	0,1
Loxoconchidae	2,7	2,9	2,8
<i>Palmoconcha walvisbaiensis</i> (Hartmann)	2,3	2,1	2,3
<i>Palmoconcha? walvisridgensis</i> sp. nov.	0,1	0,5	0,1
<i>Kuiperiana angulata</i> sp. nov.	0,2	0,2	0,3
<i>Palmoconcha subrhomboidea</i> (Brady)	0,1	0,1	0,1

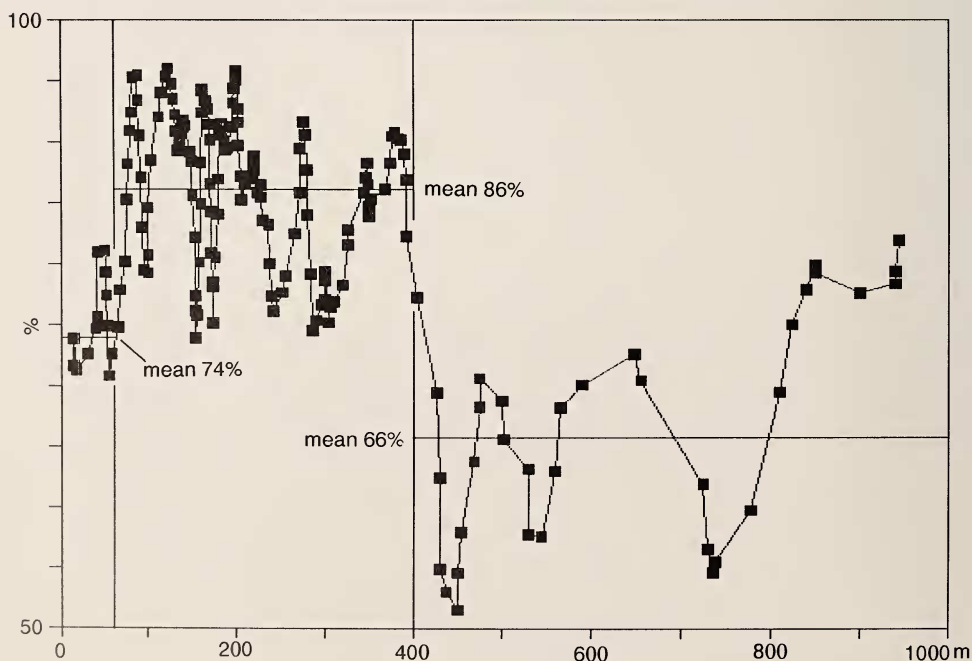


Fig. 2. Distribution with depth across the continental margin of south-western Africa of the combined abundances of the dominant species (5-point running mean of percentage of total ostracod fauna). Mean values for various shelf zones are shown by horizontal lines. The faunas described herein are seen to be primarily typical of the continental shelf (60–400 m water depths).

range 400–800 m. In summary, the species dealt with in this paper are dominantly a mid-shelf to outermost shelf assemblage (60–400 m).

Using criteria based on shell preservation, all individual specimens have been classified into one of two categories: 'modern' (i.e. living, or dead but well preserved, translucent valves) and 'relict' (opaque valves that are abraded and/or corroded). In terms of overall population abundance, the rankings of the dominant taxa are similar for the two categories (Fig. 3), the main difference being the relatively greater importance of *Bensonkia knysnaensis* in the modern fauna (2nd) compared to the relict populations (5th). However, the dominance of *Pseudokeijella lepralioides* is much greater in the modern (67,9%) than in the relict fauna (34,5%), and contrasts with a

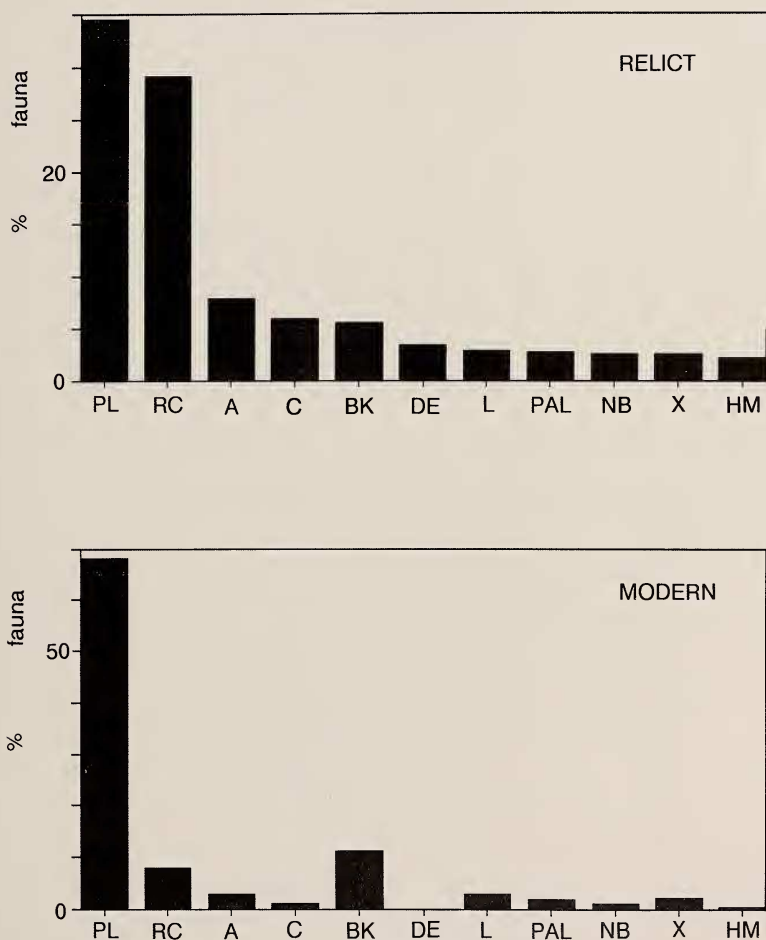


Fig. 3. Rankings of the dominant taxa in the total relict and modern ostracod assemblages from the continental margin of south-western Africa (shown as a percentage of the fauna of the samples in which they occur). Abbreviations: PL—*Pseudokeijella lepralioides*, RC—*Ruggieria cytheropteroides*, A—*Ambostracon* (A.) spp., C—*Cytherella* spp., BK—*Bensonkia knysnaensis*, DE—*Doratocythere exilis*, L—loxoconchids, PAL—*Paracypris lacrimata*, NB—*Neocytherideis boomeri*, X—*Xestoleberis* spp., HM—*Henryhowella melobesioides*.

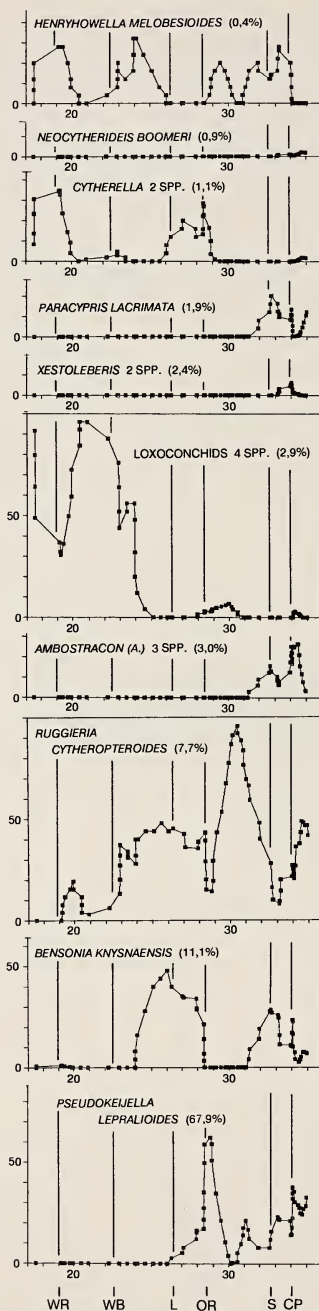


Fig. 4. Latitudinal abundances of species in modern populations expressed as percentages of the modern fauna, arranged in descending order of overall abundance (in parenthesis). Data are double 5-point running means. Vertical scale = percentage, horizontal scale = degrees of latitude. Abbreviations: WR—north edge of Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; S—Saldanha; CP—Cape Peninsula.

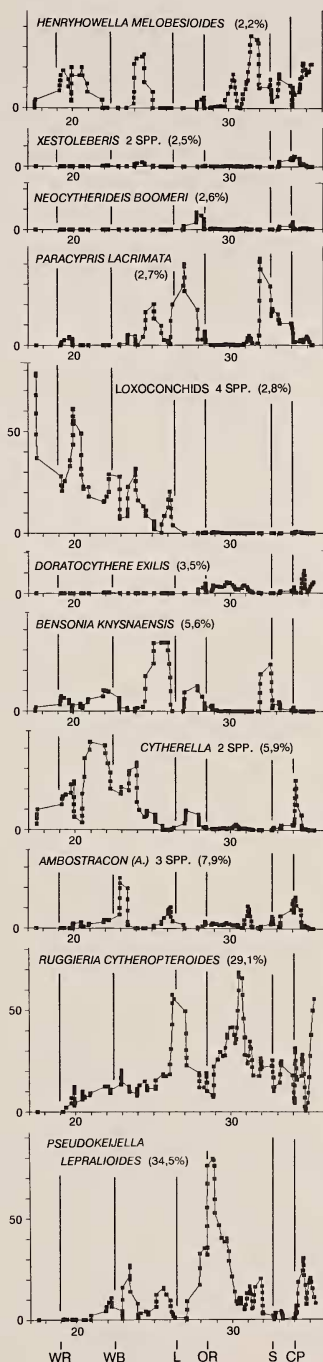


Fig. 5. Latitudinal abundances of species in relict populations expressed as percentage of the whole fauna; arranged in descending order of overall abundance (in parenthesis). Data are double 5-point running means. Vertical scale = percentage, horizontal scale = degrees of latitude. Abbreviations: WR—north edge of Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; S—Saldanha; CP—Cape Peninsula.

corresponding diminution in importance in *Ruggieria cytheropteroides* (7,7% and 29,1%, respectively). In addition, *Doratocythere exilis* (6th ranking in relict populations), has not been identified in the modern fauna. Invariably, the regional distribution of the modern and relict populations of each species show differences (Figs 4, 5), details of which will be presented for individual species in the taxonomic notes, with a brief summary in the discussion section at the end of the paper.

Sediment samples used in this study were retrieved from the top 10 cm of the sea-floor using a Van Veen grab. They were collected from the University of Cape Town's research vessel 'Thomas B. Davie' (sample numbers have a TBD prefix), and the original samples are retained in the store of the Marine Geoscience Unit, University of Cape Town.

Microfossils were picked from 125-micron and larger sieve fractions, and numbered specimens are lodged in the micropalaeontology collections at the South African Museum, Cape Town, under the catalogue prefix SAM-PQ-MF.

LIST OF GENERA AND SPECIES

The genera and species of Ostracoda discussed in this work are given below:

	PAGE
<i>Cytherella</i> Jones, 1849	17
<i>Cytherella dromedaria</i> Brady, 1880	
<i>Cytherella namibensis</i> sp. nov.	
<i>Paracypris</i> Sars, 1866	25
<i>Paracypris lacrimata</i> sp. nov.	
<i>Doratocythere</i> McKenzie, 1967	29
<i>Doratocythere exilis</i> (Brady, 1880)	
<i>Bensonina</i> Rossi de Garcia, 1969	32
<i>Bensonina knysnaensis knysnaensis</i> (Benson & Maddocks, 1964)	
<i>Bensonina knysnaensis robusta</i> subsp. nov.	
<i>Neocytherideis</i> Puri, 1952	35
<i>Neocytherideis boomeri</i> sp. nov.	
<i>Ambostracon</i> Hazel, 1962	42
<i>Ambostracon (Ambostracon) flabellcostata</i> (Brady, 1880)	
<i>Ambostracon (Ambostracon) levetzovi</i> (Klie, 1940)	
<i>Ambostracon (Ambostracon) keeleri</i> sp. nov.	
<i>Palmoconcha</i> Swain & Gilby, 1974	54
<i>Palmoconcha walvisbaiensis</i> (Hartmann, 1974)	
<i>Palmoconcha? walvisridgensis</i> sp. nov.	
<i>Palmoconcha subrhomboidea</i> (Brady, 1880)	
<i>Kuiperiana</i> Bassiouni, 1962	61
<i>Kuiperiana angulata</i> sp. nov.	
<i>Ruggieria</i> Keij, 1957	63
<i>Ruggieria cytheropteroides</i> (Brady, 1880)	
<i>Henryhowella</i> Puri, 1957	68
<i>Henryhowella melobesioides</i> (Brady, 1869)	

<i>Pseudokeijella</i> gen. nov.	71
<i>Pseudokeijella lepralioides</i> (Brady, 1880)	
<i>Xestoleberis</i> Sars, 1866.	77
<i>Xestoleberis africana</i> Brady, 1880	
<i>Xestoleberis hartmanni</i> sp. nov.	

SYSTEMATIC DESCRIPTIONS

The classification used here is based on (Moore 1961), with various additions necessitated by subsequent work.

Abbreviations used: AM = anterior margin; ATE = anterior terminal element; C = carapace; CA = cardinal angle; DM = dorsal margin; LV = left valve; MA = marginal area; ME = median element; MPC = marginal pore canal; MS = muscle scars; NPC = normal pore canal; PM = posterior margin; PTE = posterior terminal element; RV = right valve; SCT = subcentral tubercle; VM = ventral margin.

In the discussion of ostracod distributions, UDL, and LDL = upper depth limit, and lower depth limit, respectively.

Class CRUSTACEA Pennant, 1777
 Subclass OSTRACODA Latreille, 1806
 Order PODOCOPIDA Müller, 1894
 Suborder PLATYCOPINA Sars, 1866
 Family **Cytherellidae** Sars, 1866

Genus *Cytherella* Jones, 1849

At least twelve species of *Cytherella* have been reported from the late Cenozoic of southern Africa, seven from the Quaternary. Four of these occur on the continental shelf of south-western and southern Africa: *Cytherella dromedaria* Brady, 1880—west coast shelf; *Cytherella namibensis* sp. nov.—west coast shelf; *Cytherella* aff. *C. punctata* Brady, 1866 (Benson & Maddocks 1964)—Knysna Lagoon; and *Cytherella omatsolai* Hartmann, 1974—coastal zone, Luanda to Sandwich Harbour.

Cytherella dromedaria Brady, 1880

Fig. 6A–D

Cytherella dromedaria Brady, 1880: 173, pl. 43 (figs 6a–b). Puri & Hulings, 1976: 312, pl. 24 (fig. 14).
Cytherella sp. aff. *C. cuneiformis* Hartmann, 1974. Keeler, 1981: 185–187, pl. 11 (figs 1–3).

Illustrated material.

SAM-PQ-MF-0509, LV, TBD 6824, 90 m
 SAM-PQ-MF-0510, RV, TBD 6824, 90 m
 SAM-PQ-MF-0511, RV, TBD 6824, 90 m
 SAM-PQ-MF-0512, C, TBD 6824, 90 m

Material

702 valves.

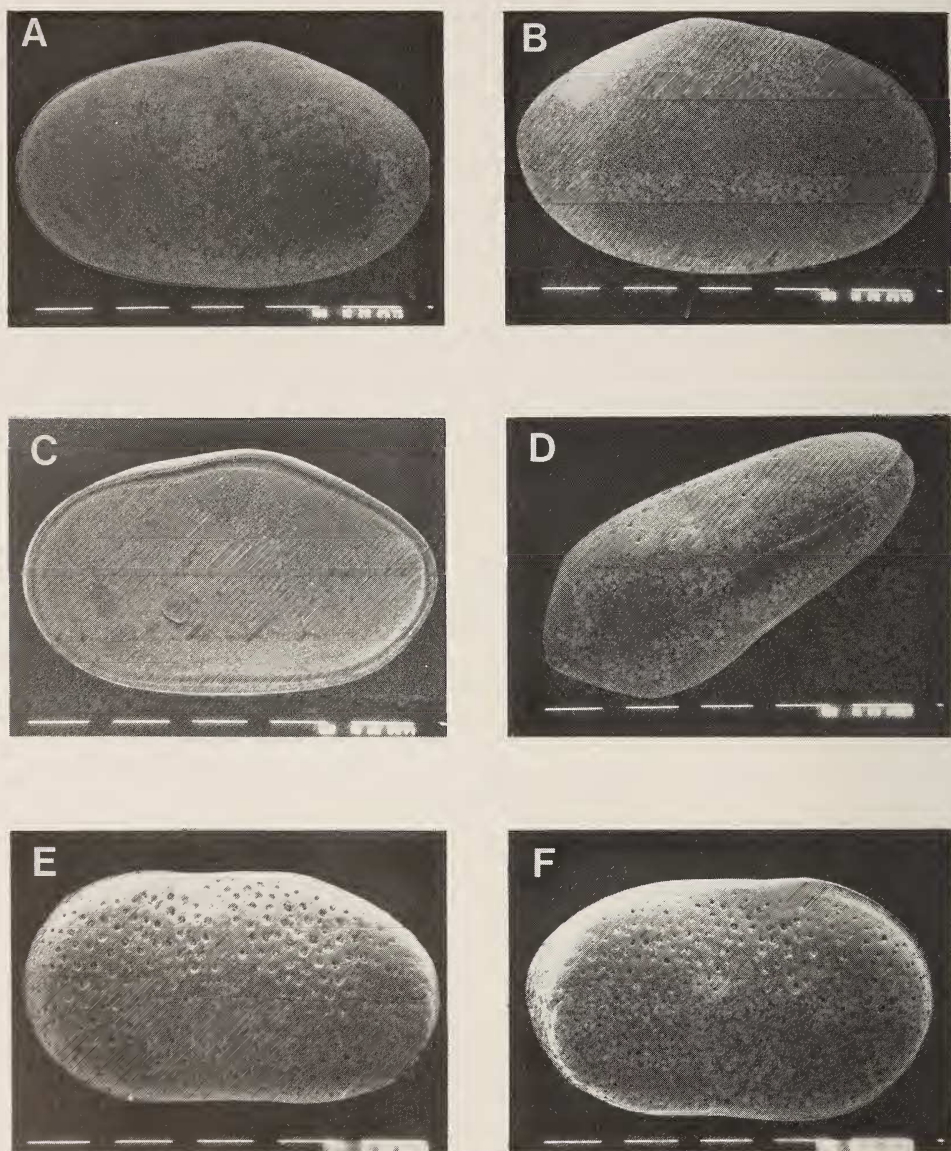


Fig. 6. A-D. *Cytherella dromedaria* Brady, 1880, TBD 6824, 90 m. A. SAM-PQ-MF0509, LV SEM 2575. B. SAM-PQ-MF0510, RV, SEM 2573. C. SAM-PQ-MF0511, RV, SEM 2577. D. SAM-PQ-MF0512, carapace, dorsal view, SEM 2582. E-F. *Cytherella namibensis* sp. nov. TBD 2975, 180 m. E. SAM-PQ-MF0513, holotype, LV, SEM 2643. F. SAM-PQ-MF0514, RV, SEM 2640. Scale bars = 100 microns.

Remarks

This distinctive species has a strongly gibbous DM, and numerous large normal pore openings on the lateral surface. The AM in each valve has a very narrow rim that is clearly seen in dorsal view.

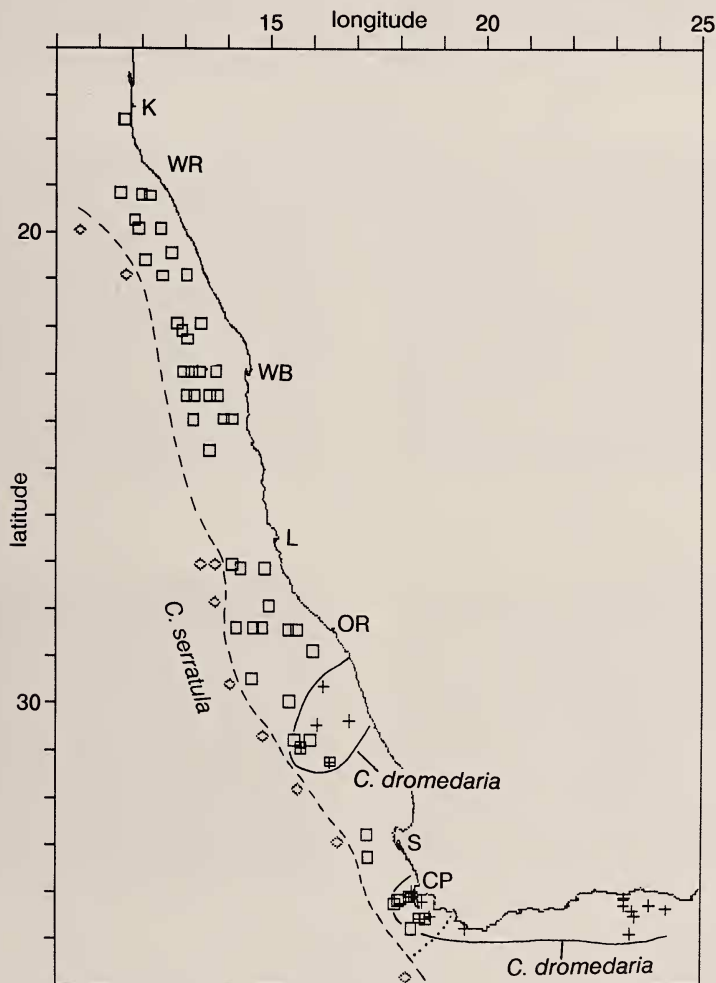


Fig. 7. Distribution of *Cytherella* spp. Squares—*C. namibensis* sp. nov. (southern limit shown as dotted line south-east of the Cape Peninsula); crosses—*C. dromedaria* (Brady) (seaward limit shown by solid line); diamonds—*C. serratula* (Brady) (landward limit shown by dashed line, after Dingle *et al.* 1990). Abbreviations for this and subsequent distribution maps: K—Kunene River; WR—Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; S—Saldanha; CP—Cape Peninsula.

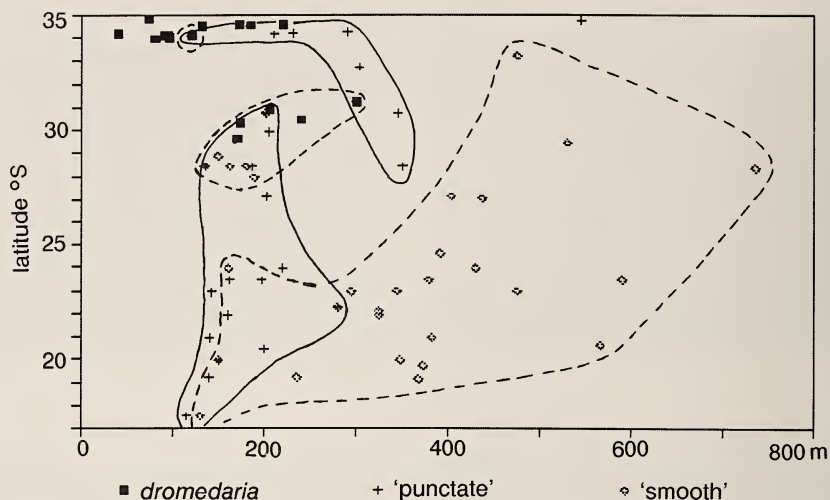


Fig. 8. Latitudinal water-depth distribution of sites with *Cytherella dromedaria* and *C. namibensis* sp. nov. Field outlines: solid line = 'punctate' variety of *C. namibensis*; dashed line = 'smooth' variety of *C. namibensis*.

Distribution

Brady (1880) originally recorded this species from 'Challenger' Station 104 in False Bay. The present data indicate that it is confined to the west and south coast continental margins south of 29,5°S (Fig. 7).

Modern specimens were recovered from two sites: west of Hout Bay (94 m) and west of Cape Agulhas (73 m).

Relict populations are confined to two areas. The northernmost lies on the middle to outer shelf (170–300 m—Fig. 8) between the Orange and Olifants rivers, where abundances are generally low (>5% at one of four sites). A southern population (central Cape Peninsula to the eastern Agulhas Bank) has UDL and LDL of 40–220 m, and includes the two modern sites. Abundances in the southern sector are relatively high (>5% at four of eleven sites), and the preferred water depth of the relict populations of *Cytherella dromedaria* was c. 100 m (Fig. 11).

Cytherella namibensis sp. nov.

Figs 6E–F, 9A–D, 10A

?*Cytherella sordida* Müller, 1894. Bold, 1966: 158–159, pl. 1 (fig. 10).

?*Cytherella* aff. *C. sordida* Müller, 1894. Dingle, 1976: 39, fig. 12 (39).

Cytherella spp. Boomer, 1985: 12–13, pl. 1 (figs 16–17).

Derivation of name

From the type locality of the species adjacent to the Namib Desert, south-western Africa.

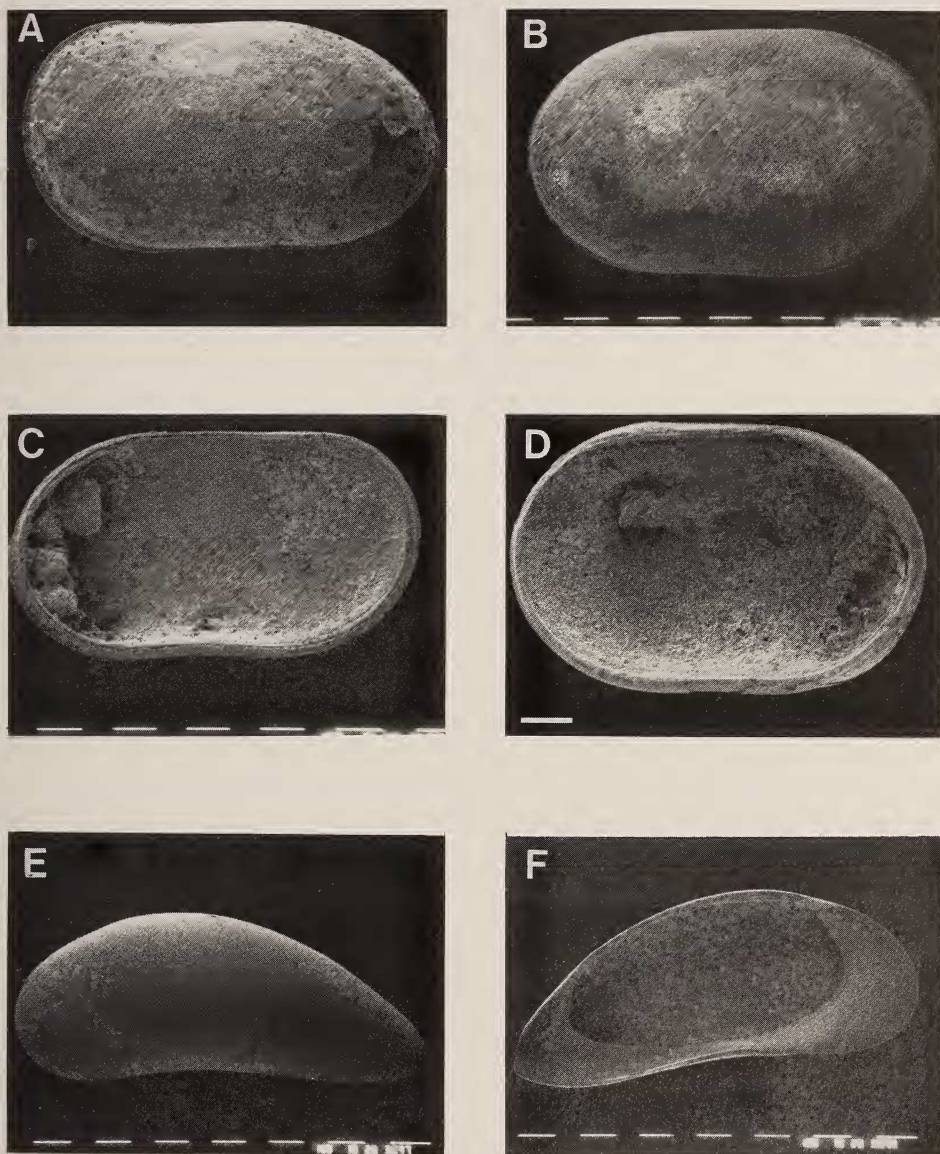


Fig. 9. A-D. *Cytherella namibensis* sp. nov. A-C. TBD 2971, 162 m. A. SAM-PQ-MF0515, LV, SEM 2648. B. SAM-PQ-MF0516, RV, SEM 2647. C. SAM-PQ-MF0517, LV, SEM 2650. D. SAM-PQ-MF0518, RV, TBD 2975, 180 m, SEM 2645. E-F. *Paracypris lacrimata* sp. nov., TBD 6846, 95 m. E. SAM-PQ-MF0519, holotype, LV, SEM 3047. F. SAM-PQ-MF0520, LV, SEM 3045. Scale bars = 100 microns.

Holotype

	length	height
SAM-PQ-MF-0513, LV, TBD 2975, 180 m	0,68 mm	0,39 mm

Paratypes

	length	height
SAM-PQ-MF-0514, RV, TBD 2975, 180 m	0,70 mm	0,42 mm
SAM-PQ-MF-0515, LV, TBD 2971, 162 m	0,75 mm	0,42 mm
SAM-PQ-MF-0516, RV, TBD 2671, 162 m	0,93 mm	0,60 mm
SAM-PQ-MF-0517, LV, TBD 2971, 162 m	0,80 mm	0,48 mm
SAM-PQ-MF-0518, RV, TBD 2975, 180 m	0,72 mm	0,50 mm

Material

423 valves.

Diagnosis

Punctate species of *Cytherella* with greatest height in anterior third. AM outline has a bulbous appearance, posterodorsal outline slopes steeply posteriorly, DM is straight, but the dorsal outline in lateral view is distinctly concave. Posteroventral area of valve is inflated, and has a curved, angular outline.

Description

The AM is broadly and symmetrically rounded. Bulbous in lateral view because the greatest height lies in the anterior third of the valve. PM outlines differ: in LV the outline is asymmetric, with a distinctive posterodorsal slope, whereas in RV the outline is more symmetric, although there is slight acumination along the line of greatest length. In both valves the DM and VM are essentially straight, but the outline of the former in lateral view is distinctly concave around mid-length. In both valves there is a small but distinctive posteroventral angularity, that in RV forms a slight angular projection.

Surface ornamentation punctate, it grades from punctate overall, to specimens in which the main punctation is confined to the PM, with rare, scattered puncta in the anterior half of the valve.

Internal features are typical for the genus.

Remarks

The end members of the 'punctate' and 'smooth' series are easily distinguished, and overall their geographical distributions are distinct. It is tempting to split the group into two species but, in the case of numerous individuals, the distinction would be arbitrary.

Brady (1880) did not record *Cytherella* from 'Challenger' Station 142 on the continental shelf off the Cape of Good Hope, but illustrated several punctate specimens from widely separated localities under the name *C. punctata* Brady, 1866. The types of the latter are from the eastern Mediterranean and have a distinct dorsomedian depression, and have a straighter DM than *C. namibensis*. Of the specimens allocated to *C. punctata* in the 'Challenger' report (Brady 1880), those from Port Jackson (Aus-

tralia) are closest to the types, whereas all others all have a distinct reniform outline. In the latter category he presumably included material from Tristan da Cunha.

Benson & Maddocks (1964) recorded living punctate specimens of a species referred to *Cytherella* aff. *C. punctata* Brady, 1866, from the Knysna Lagoon. These differ significantly in lateral outline from *C. namibensis*. Their highest point is in the posterior half and they have relatively narrow AM outlines and a straighter DM. Similarly, Hartmann's (1974) species *C. cuneiformis* (coastal Angola) has a strikingly different DM outline to my species (Fig. 10).

In their survey off the River Congo estuary (R. Zaire, 11 m to at least 50 m water depth), Babinot & Kouyoumontzakis (1986) found *Cytherella* sp. aff. *C. punctata* Brady to be the most abundant ostracod taxon. From their clear illustrations it is confidently concluded that they were not dealing with *C. namibensis* because the highest point in the valve outline lies in the posterior part.

Two previously reported Tertiary species from the region are close to *C. namibensis*. These are *C. sordida* Müller (Bold 1966) from Gabon, and *Cytherella* aff. *C. sordida* Müller (Dingle 1976). Both are punctate, and differ only slightly in lateral outline from *C. namibensis*, with which they may be conspecific.

Distribution

Cytherella namibensis sp. nov. occurs along the entire south-west African continental shelf (Fig. 7), but usually there is a subdivision into areas populated by the 'punctate' and 'smooth' varieties.

Modern specimens occur at locations scattered along the shelf from 17.5°S to 28°S (Orange River), where they occupy a depth range 115–295 m. The main cluster lies on the Orange Shelf. Both 'punctate' and 'smooth' varieties occur here.

Relict specimens occur from 17.5°S to the Cape Peninsula, but Keeler (1981) did not find the species on the eastern Agulhas Bank. Almost invariably, the 'punctate'

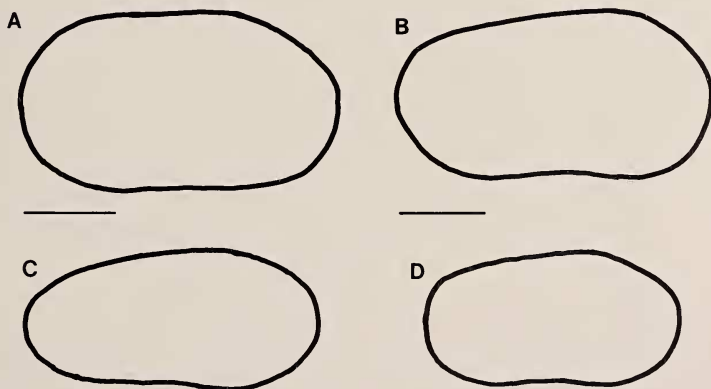


Fig. 10. Outlines of LV of *Cytherella* species. A. *C. namibensis* sp. nov., SAM-PQ-MF0513, holotype, TBD 2975, 180 m. B. *Cytherella* aff. *C. punctata* Brady, 1866, Benson & Maddocks 1964, Knysna estuary, traced from Benson & Maddocks (1964, pl. 1 (fig. 2)). C. *C. cuneiformis* Hartmann, 1974, Angola, traced from Hartmann (1974, pl. 13 (fig. 104)). D. *C. omatsolai* Hartmann, 1974, Angola, traced from Hartmann (1974, pl. 11 (fig. 82)). Scale bars = 200 microns; other scales not known.

variety of the species occurs at shallower water depths than the 'smooth' variety. The 'punctate' variety also predominates off the Cape Peninsula; only two sites south of 31°S yielded the 'smooth' variety. The depth-related partition between the two varieties is well-illustrated in Figure 8. This shows that the 'punctate' type has UDL and LDL between 115 m and 280 m off the Walvis–Orange sector and between 120 m and 345 m off the south-western Cape, in contrast to a 130–590 m range for the 'smooth' variety. (The two sites at 535 m and 736 m, with 'punctate' and 'smooth' types, respectively, are considered allochthonous.) The depth-related preferences of the two morphotypes is further emphasized when abundances are plotted against depth (Fig. 11). The 'punctate' variety peaks at about 220 m, and the 'smooth' variety at about 380 m. Presumably this distribution is linked to depth-related environmental factors.

General remarks on the distribution of the genus Cytherella

Three species are widely distributed on the continental margin of south-western Africa: *C. dromedaria* occurs on the continental shelf south of 28°S, *C. namibensis* occurs on the continental shelf between 17,5°S and the Cape Peninsula (34°S), and *C. serratula* (Brady, 1880) occurs on the continental slope in water depths >1 000 m. Less widely distributed are two coastal species, *C. omatsolai* (as far south as Sandwich Bay, 40 km south of Walvis Bay), and *Cytherella* aff. *C. punctata* (Knysna Lagoon), and the deep-water taxon *Cytherella* sp. 3027 (Dingle *et al.* 1990—2 916 m).

The shelf species *C. dromedaria* and *C. namibensis* both have restricted modern distributions: the former is confined to the Cape Peninsula area, and the latter to areas north of 28°S. In relation to the abundances of other taxa, the modern population of *C. dromedaria* is insignificant but, between the Orange River and Lüderitz, and north of the Walvis Ridge abutment shelf, *C. namibensis* is an important component of the modern fauna (Fig. 4). This distribution suggests that *C. dromedaria* and

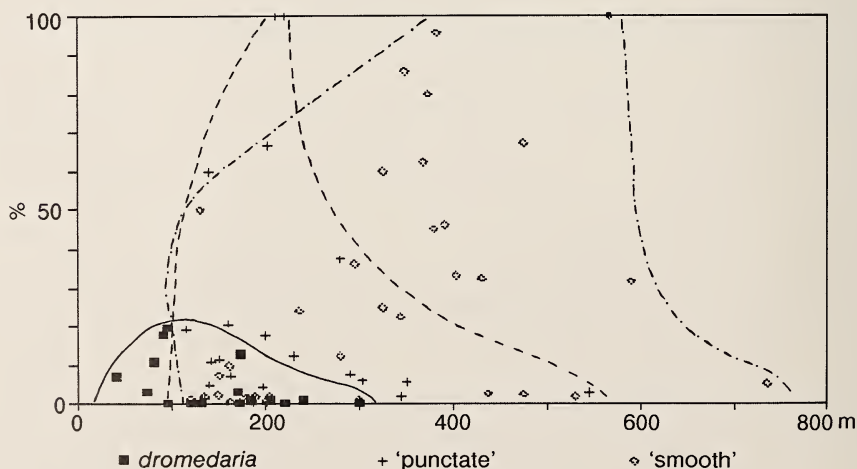


Fig. 11. Abundance of *Cytherella dromedaria* and *C. namibensis* sp. nov. as percentage of ostracod fauna plotted against water depth. Field outlines: solid line = *C. dromedaria*, dashed line = 'punctate' variety of *C. namibensis*, dot-dashed line = 'smooth' variety of *C. namibensis*.

C. namibensis can be considered characteristic of shallow, warm, Agulhas water, and cold west-coast mid-shelf conditions, respectively.

The range of both species is extended in the relict faunas; *C. dromedaria* to the north, and *C. namibensis* to the south, although this was mainly in the 'punctate' variety, exhibiting the tendency of this morphotype to favour inner shelf areas. Considering their relative abundance by latitude (Fig. 5), *C. dromedaria* locally forms an important component of the relict population in the Cape Peninsula–Saldanha Bay area, whereas *C. namibensis* is either the dominant, or one of the dominant species, in the relict ostracod populations over a wide sector of the continental shelf from north of the Walvis Ridge abutment to between Walvis Bay and Lüderitz. South of this it is generally a minor component.

There is a sharp break between the distribution of the neritic (shelf) species and the bathyal *C. serratula*. This has been attributed to the environmental barrier formed by the core of the salinity minimum zone in the Antarctic Intermediate Water at about 750 m (Dingle *et al.* 1989, 1990, fig. 3).

Superfamily CYPRIDACEA Baird, 1845

Family **Paracyprididae** Sars, 1923

Genus *Paracypris* Sars, 1866

In the open literature, only one Quaternary species of this genus has previously been recorded from southern Africa: *Paracypris westfordensis* Benson & Maddocks, 1964, from Knysna Lagoon. No records were made by Brady (1880), Müller (1908), Klie (1940), and Hartmann (1974) in their studies of the region, nor was it recorded by Bold (1966) in the Neogene of Gabon.

Fossil records of the genus in southern Africa have been made from the Cretaceous (e.g. Dingle 1981) and Tertiary (Dingle 1976).

Paracypris lacrimata sp. nov.

Figs 9E–F, 12C, F

Paracypris sp. aff. *P. polita* Sars, 1866. Keeler, 1981: 34–35, pl. 1 (fig. 14).

Paracypris sp. Keeler, 1981: 35–36, pl. 1 (fig. 15).

Pontocypris sp. Boomer, 1985: 16–17, pl. 4 (fig. 64).

Derivation of name

Lacrima—Latin, tear. Refers to tear-shape of valve.

Holotype

	length	height
SAM–PQ–MF–0519, LV, TBD 6846, 95 m	1,24 mm	0,50 mm

Paratypes

	length	height
SAM–PQ–MF–0520, LV, TBD 6846, 95 m	1,20 mm	0,50 mm
SAM–PQ–MF–0521, RV, TBD 6846, 95 m	1,31 mm	0,48 mm
SAM–PQ–MF–0522, LV fragment, TBD 6846, 95 m		

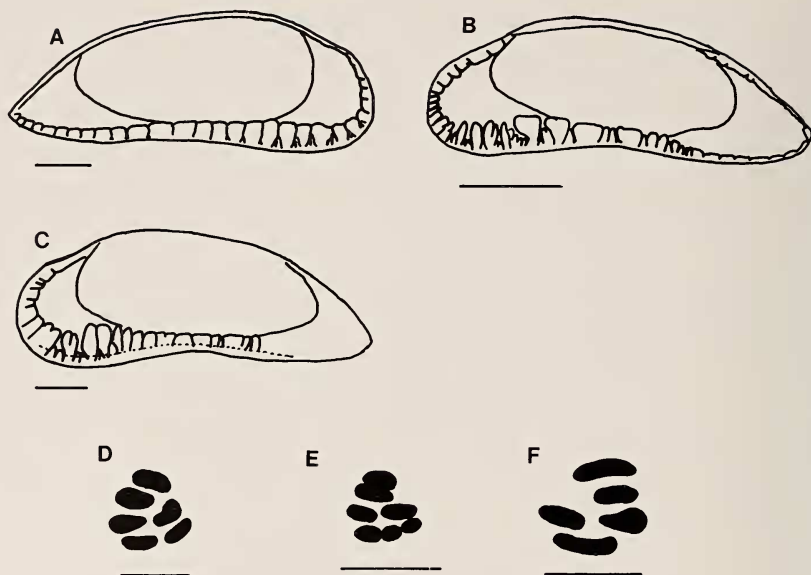


Fig. 12. A–F. *Paracypris*. A, D. *P. polita* Sars, internal view and MS, LV, north-western Europe, traced from Sars (1928, pl. 31). B, E. *P. bradyi* McKenzie, internal view and MS, RV, south-eastern Australia, traced from McKenzie (1967, fig. 2d). C, F. *P. lacrimata* sp. nov., TBD 6846, 95 m. C. SAM-PQ-MF0521, internal view, RV. F. SAM-PQ-MF0522, MS, LV. Scale bars: A–C = 200 microns; D–F = 100 microns.

Material

547 valves.

Diagnosis

Species of *Paracypris* with long, asymmetrical, pointed PM whose apex is strongly ventrally directed. DM strongly convex and VM concave. Highest point lies at about one-quarter valve length. There are c. 15 branched anterior radial pore canals, and a MS pattern in which the four anterior-most scars are longitudinally aligned.

Description

External features. Broadly rounded AM that is somewhat ventrally directed, and a strongly acuminate PM that is also ventrally directed. DM strongly arched, with the highest point at about one-quarter valve length. VM concave. Overall the outline is tear-drop or comma shaped. RV outline has an anterodorsal step.

Internal features. Wide anterior and posterior vestibulae with c. 15 simple and branched anterior radial canals that are larger and more complex anteroventrally. The MS consist of five scars, all elongate, with the four anterior-most aligned longitudinally. The hinge is adont.

Remarks

Many of the penultimate instars have a reddish-brown ?chitinous lining to the outer lamella, which gives the valves a reddish hue seen externally. Also, because

these instars appear to be particularly susceptible to decalcification in deeper waters, the presence of the species is recorded as residual brown 'husks'. Sars (1923: 70) in his re-appraisal of his genus mentions that the type species *P. polita* has a reddish brown hue along the ventral side of the valves and that the marginal areas are 'highly chitinated'.

Paracypris lacrimata sp. nov. is very close in both outline and internal features to the holotype *P. polita* Sars, 1866. The new species is slightly more arched along the DM and concave on the VM, giving it a more pronounced tear-drop or comma-like appearance. The definitive differences are in the greater asymmetry and complexity of the AM radial pore canals of the new species, and differences in MS pattern (see

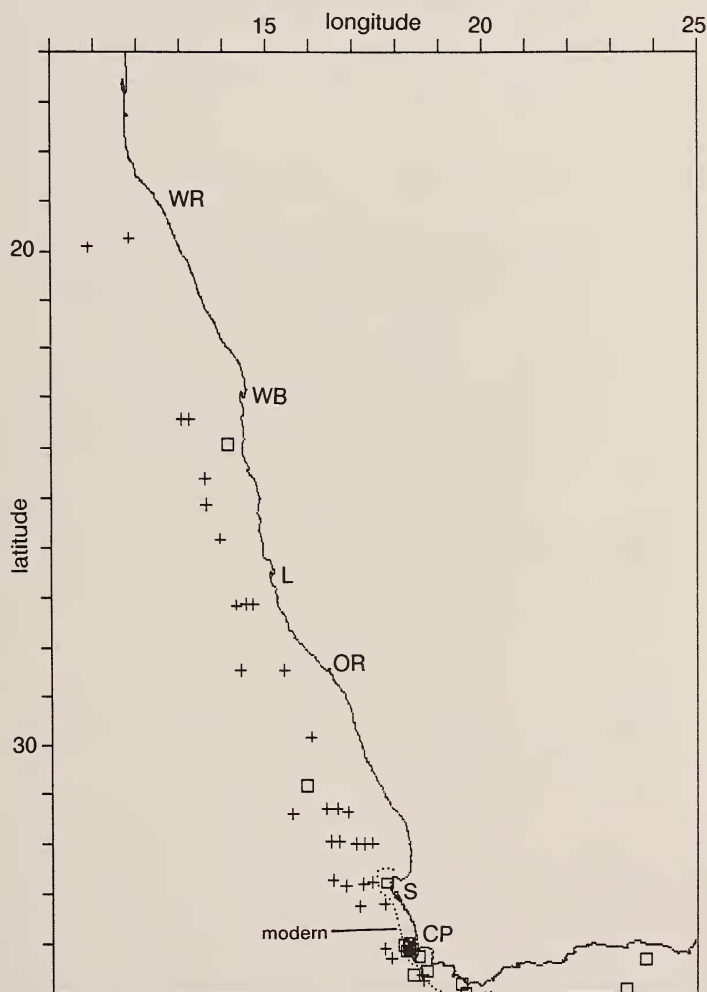


Fig. 13. Distribution of *Paracypris lacrimata* sp. nov. Squares = sites with calcareous valves; crosses = sites with red/brown husks. Dotted line is the seaward limit of modern populations. See Fig. 7 for abbreviations.

Fig. 12). *Paracypris lacrimata* lacks the prominent eye spot described by Sars (1923) for *P. polita*.

A further close relative is *P. bradyi* McKenzie, 1967, from south-east Australia. This species has more numerous AM radial pore canals and a different outline in both the AM and PM inner lamella. There is a slight difference in MS disposition between the two species (Fig. 12).

Although it occurs geographically close by, *P. westfordensis* Benson & Maddocks, 1964, from the Knysna Lagoon is easily distinguished by being less acuminate posteriorly, and having a less broadly rounded AM outline.

Distribution

Specimens of *P. lacrimata* occur along the continental shelf from 19°S (Walvis Ridge shelf) to the south-western Cape and across to the eastern Agulhas Bank (Fig. 13).

Modern populations all lie in a depth range 15–133 m between Saldanha Bay and Cape Agulhas.

Relict distribution is complicated by post-mortem decalcification (?by oxygen-depleted waters). These populations extend as far north as the Walvis Ridge but, with two exceptions, all the specimens north of 33°S consist of chitinous husks. These presumably represent decalcified material, because the two calcareous valves mentioned are in a poor state of preservation. Off the south-western Cape, relict populations consist of calcified material, with only a small proportion of chitinous 'valves'. The depth ranges over which these relict populations are found varies with latitude (Fig. 14). North of 27°S, the UDL is >200 m (with the exception of the calcite valve from 24°S at 161 m), but farther south, the UDL of the chitinous material is c. 150 m, and off the south-west the shallowest depth with 'husks' is 94 m. The LDL increases

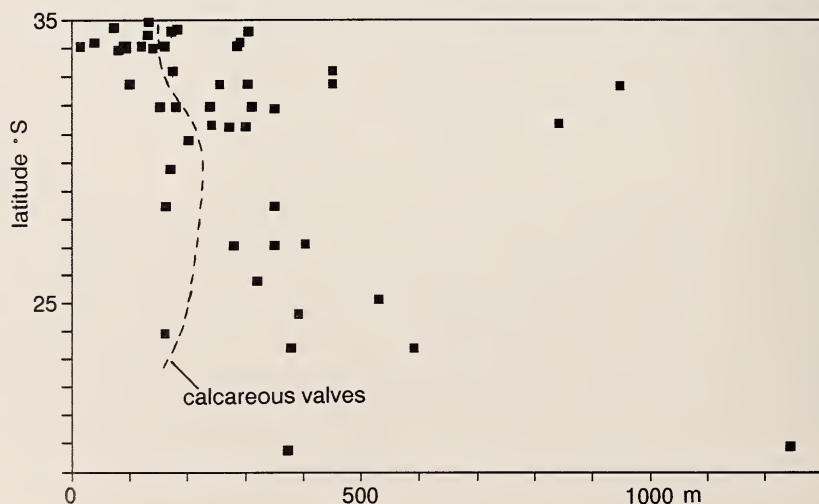


Fig. 14. Latitudinal water-depth distribution of sites with *Paracypris lacrimata* sp. nov. Dashed line shows LDL of specimens with calcareous valves.

northwards, from 450 m in the south, to 590 m near Walvis Bay. The three records of single specimens at >800 m are probably allochthonous because they are so much farther downslope.

Superfamily CYTHERACEA Baird, 1850

Family **Campylocytherididae** Puri, 1960

Subfamily Campylocytheridinae Puri, 1960

Genus *Doratocythere* McKenzie, 1967

McKenzie (1967) erected this genus for certain species that occur at inshore locations along the coast of southern Australia. It has since been reported from Japan (Ishizaki & Matoba 1985), but the illustrations in this publication do not appear very close to the types illustrated by McKenzie (1967). Kempf (1988) cited no additional records of the genus, so currently available records probably confine the genus to the Southern Hemisphere.

Doratocythere exilis (Brady, 1880)

Fig. 15A–F

Cythere exilis Brady, 1880: 69, pl. 16 (figs 5a–h). Puri & Hulings, 1976: 276, pl. 10 (figs 1–11).

Doratocythere exilis (Brady, 1880) Keeler, 1981: 39–41, pl. 1 (figs 20–22).

Reymentia exilis (Brady, 1880) Boomer, 1985: 49–50, pl. 2 (fig. 21).

Illustrated material

SAM–PQ–MF–0523, LV, TBD 2975, 180 m

SAM–PQ–MF–0524, RV, TBD 2975, 180 m

SAM–PQ–MF–0525, LV, TBD 2975, 180 m

SAM–PQ–MF–0526, RV, TBD 2975, 180 m

SAM–PQ–MF–0527, C, TBD 6824, 90 m

Material

673 valves.

Remarks

Brady's (1880) species accords well with McKenzie's (1967) descriptions and illustrations of the type species (*D. foveata*). There are three points of difference:

1. In *D. exilis* there is no appreciable thickening of the valve wall in the vicinity of the ATE.
2. The small 'micropunctate interscar' area of *D. foveata* could not be identified in *D. exilis*, although in well-preserved specimens a small spot lies in this position.
3. *Doratocythere exilis* has a prominent fulcral point anterodorsal to the MS. No similar feature was mentioned in the species described by McKenzie.

Of these points, the first appears to be the most significant because McKenzie (1967) emphasized its presence as generically diagnostic. However, we do not consider the difference important enough to warrant the erection of a new genus for the South African taxon.

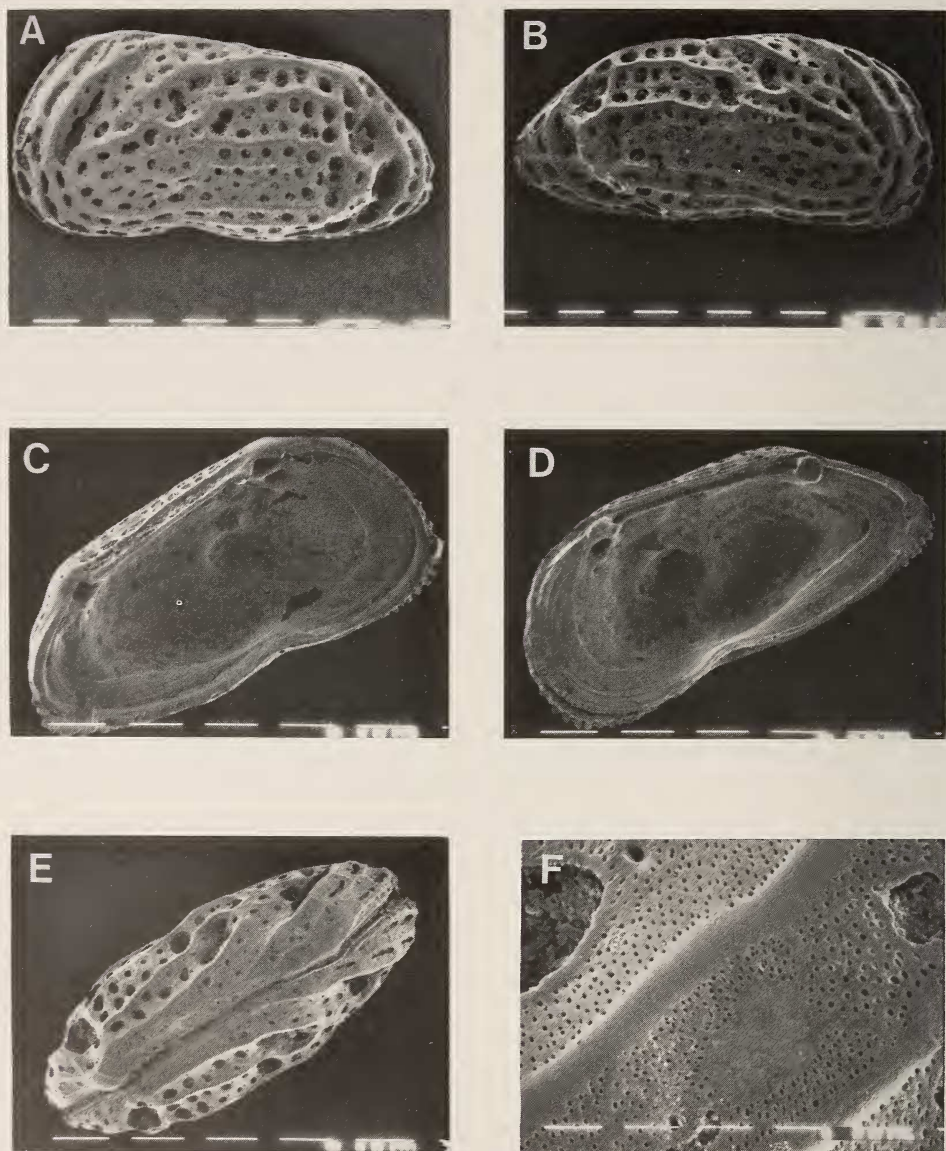


Fig. 15. A-F. *Doratocythere exilis* (Brady, 1880). A-D. TBD 2975, 180 m. A. SAM-PQ-MF0523, LV, SEM 2476. B. SAM-PQ-MF0524, RV, SEM 2478. C. SAM-PQ-MF0525, LV, SEM 2489. D. SAM-PQ-MF0526, RV, SEM 2480. E-F. SAM-PQ-MF0527, carapace, TBD 6824, 90 m. E. Dorsal view, SEM 2494. F. Detail of ornamentation, dorsal surface, mid-length, LV. Scale bars: A-E = 100 microns; F = 10 microns.

SEM photographs of *D. exilis* reveal that the crests of the prominent longitudinal ribs consist of a narrow, smooth cord, and that the flanks and non-punctate intercostal areas have a delicate secondary reticulation.

Distribution

No modern specimens of *D. exilis* were recovered.

Relict populations occur on the continental shelf from 22°S to south-western Cape, and Keeler (1981) reported the species on the eastern Agulhas Bank (Fig. 16).

The main distribution lies between 28° and 31,5°S (Orange–Namaqualand shelves), where, in several samples, the species constitutes >10 per cent of the total ostracod population. The depth range in this area is 158–305 m (Fig. 17), with the greatest abundances between 155 m and 200 m.

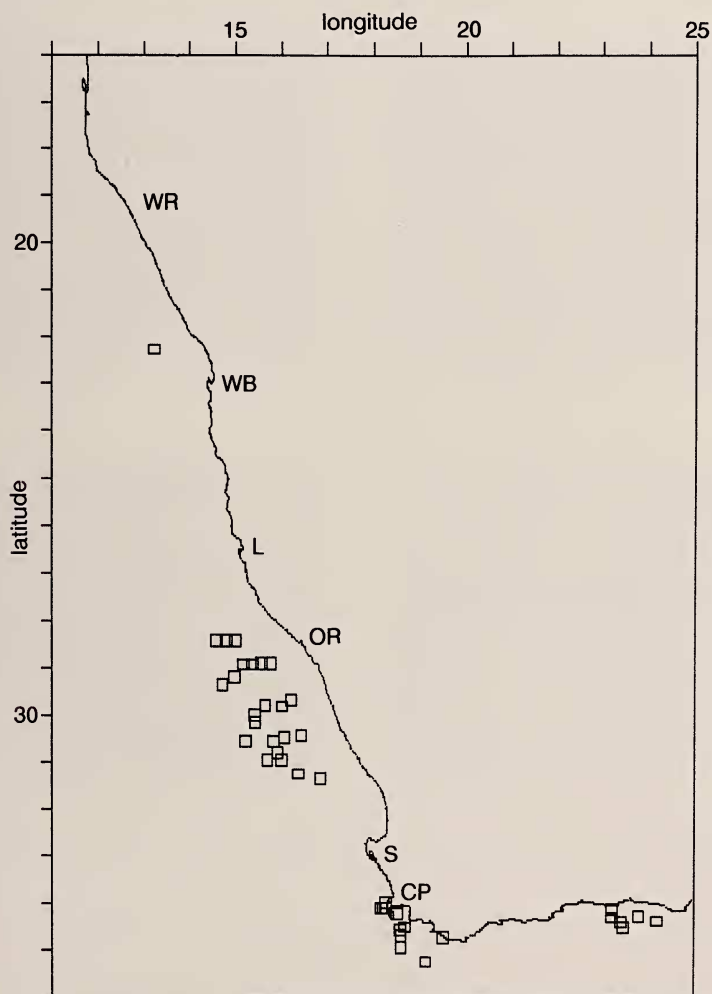


Fig. 16. Distribution of *Doratocythere exilis* (Brady). See Fig. 7 for abbreviations.

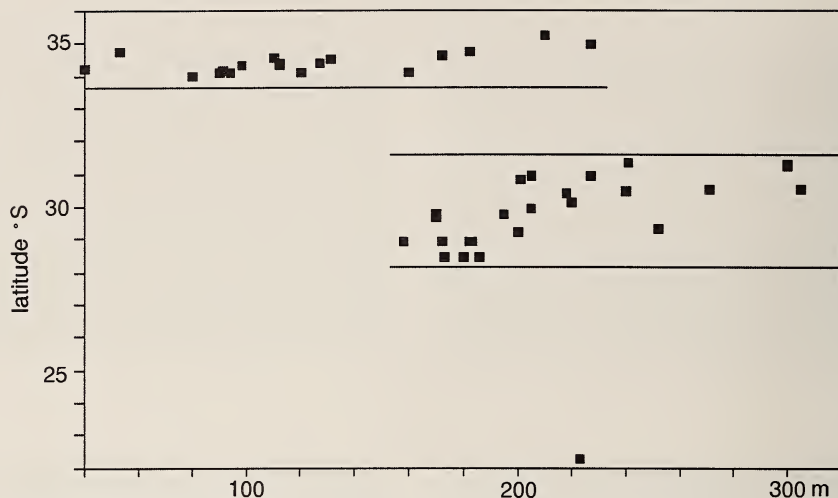


Fig. 17. Latitudinal water-depth distribution of sites with *Doratocythere exilis*. Horizontal lines delimit across-shelf populations.

A barren zone occurs between the mid-Namaqualand shelf and Saldanha, to the south of which the south-western Cape population occurs in a depth range 40–227 m. Although in this area the UDL is much shallower than farther north, the greatest abundances occur in a similar depth range to the Orange–Namaqualand population. This centre may be continuous with that on the eastern Agulhas Bank, which is within the same depth range.

A single, worn valve occurred anomalously at 22,25°S at 223 m.

Comparing the latitudinal abundance of *D. exilis* with the other dominant taxa (Fig. 5), shows that it is never more than a secondary component of the overall ostracod populations, although locally west of the Cape Peninsula it is the fourth most abundant taxon. In addition, together with *Ambostracon* spp., *D. exilis* is a characteristic element of the northern part of the Namaqualand shelf fauna.

Family Cytherettidae Triebel, 1952

Subfamily Cytherettinae Howe, 1961

Genus *Bensonina* Rossi de Garcia, 1969

This genus appears to be confined to the Atlantic Ocean. It probably first appeared in southern Africa in the Upper Eocene.

Bensonina knysnaensis knysnaensis (Benson & Maddocks, 1964)

Fig. 18A–F

Cytheretta knysnaensis Benson & Maddocks, 1964: 22–23, text-figs 11–12, pl. 2 (figs 7–11).

Bensonina knysnaensis (Benson & Maddocks, 1964) Keeler, 1981: 43–45, pl. 2 (figs 2–4).

Cytheretta sp. Boomer, 1985: 24–25, pl. 3 (fig. 44).

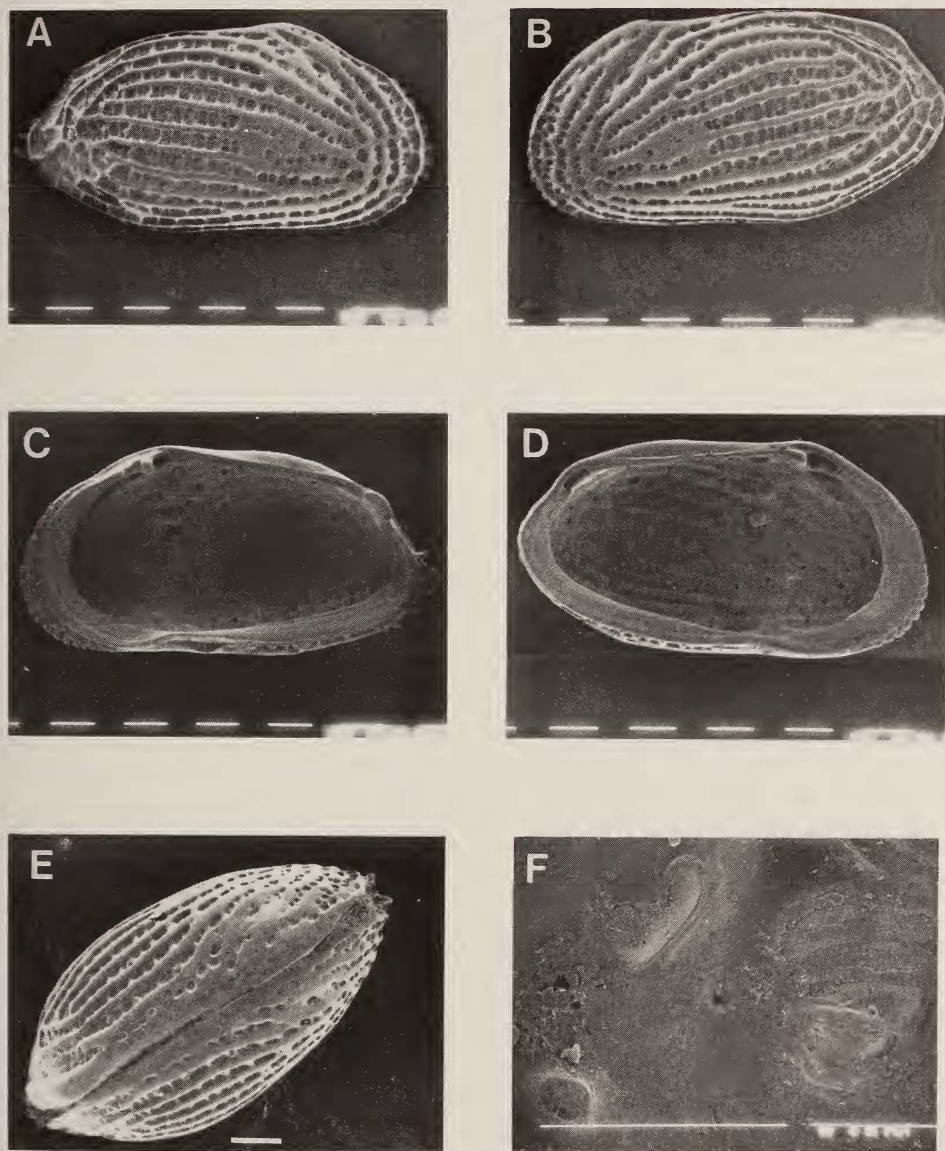


Fig. 18. A-F. *Bensonia knysnaensis knysnaensis* (Benson & Maddocks, 1964), TBD 2224, 58 m. A. SAM-PQ-MF0528, RV, SEM 2455. B. SAM-PQ-MF0529, LV, SEM 2452. C. SAM-PQ-MF0530, RV, SEM 2462. D. SAM-PQ-MF0531, LV, SEM 2459. E. SAM-PQ-MF0535, carapace, dorsal view, SEM 2456. F. SAM-PQ-MF0530, RV, MS, SEM 2464. Scale bars = 100 microns.

Illustrated material

SAM-PQ-MF-0528, RV, TBD 2224, 58 m
SAM-PQ-MF-0529, LV, TBD 2224, 58 m
SAM-PQ-MF-0530, RV, TBD 2224, 58 m
SAM-PQ-MF-0531, LV, TBD 2224, 58 m
SAM-PQ-MF-0532, C, TBD 2224, 58 m

Material

1 311 valves.

Remarks

Our material is identical to that described by Benson & Maddocks (1964) from Knysna Lagoon. The marginal areas are not typical of the genus *Cytheretta* (as mentioned by Benson & Maddocks in the original description), and the species is best accommodated in *Bensonina*, erected by Rossi de Garcia (1969) for material from the Miocene of Argentina.

A, species with very similar ornamentation (slightly coarser ribbing), lateral outline, and hinge structure was recorded as *?Leguminocythereis* sp. 1 from the Upper Eocene of the JC-1 borehole offshore Natal (Dingle 1976). This specimen should probably also be referred to the genus *Bensonina*.

Distribution

Benson & Maddocks (1964) recorded this species from Knysna Lagoon, where it was the dominant taxon (30%) at Leisure Island. They quoted the high- and low-water salinity ranges at this site as 33–35‰, suggesting that *B. k. knysnaensis* can tolerate salinities slightly below 'normal' marine values.

Modern populations of *B. knysnaensis knysnaensis* have been encountered in two main offshore areas (Figs 20, 21): off Lüderitz (31–88 m) and between the south-western Cape and the eastern Agulhas Bank (15–94 m), and also in Knysna Lagoon, where Hartmann (1974: 296) reported a relatively sparse fauna at Leisure Island. This pattern suggests that south of 25°S the species has a modern distribution of inshore to mid-shelf. I record a geographically isolated single modern valve at 19°S at 236 m on the Walvis Ridge abutment, the presence of which is difficult to reconcile with the main population centres. Smoothed plots of latitudinal variations in abundance of modern *B. k. knysnaensis* (Fig. 4) show that, together with *Ruggieria cytheropteroïdes*, it is the dominant taxon in the Orange River–Lüderitz sector, and the southern part of the Lüderitz–Walvis Bay shelf sector. It is also locally one of the main elements in the modern fauna in the Saldanha–northern Cape Peninsula region.

Relict specimens have a wide distribution, from 19°S on the Walvis Ridge abutment, to the eastern Agulhas Bank. The LDL increases from 172 m on the Agulhas Bank, to 236 m on the Walvis Ridge, whereas the UDL varies from inshore (15–31 m) off the south-western Cape and Lüderitz, to 139–149 m in the Orange River and Walvis Ridge areas. Plotting water depth against the percentage of the species in the total ostracod assemblage (Fig. 22) suggests a preferred water depth of 35–95 m. Latitudinal distributions (Fig. 5) show that *B. k. knysnaensis* is an important element in the relict faunas immediately north of Lüderitz, and immediately north of Saldanha.

Bensonia knysnaensis robusta subsp. nov.

Fig. 19A–D

*Derivation of name**robustus*, Latin, strong—reference to thickened rib ornamentation.*Holotype*

	length	height
SAM–PQ–MF–0532, LV, TBD 3972, 200 m	0,71 mm	0,37 mm

Paratypes

	length	height
SAM–PQ–MF–0533, RV, TBD 3972, 200 m	0,68 mm	0,35 mm
SAM–PQ–MF–0534, RV, TBD 3972, 200 m	0,70 mm	0,35 mm

Material

43 valves.

Diagnosis

A heavily celated subspecies of *Bensonia knysnaensis* with thickened rib ornamentation and a smooth anterodorsal surface.

Description

Overall valve architecture and ornamentation are the same as in *B. knysnaensis knysnaensis*, but in the new subspecies individual longitudinal ribs are thicker, with a consequent diminution in size of intercostal grooves and pits. In addition, the anterodorsal region is heavily calcified, resulting in a smooth, plate-like area centred on the eye spot. Similarly calcified, but less extensive areas occur posterodorsally, and over the subcentral region that overlies the MS. Internal features are identical with *B. knysnaensis knysnaensis*.

Remarks and distribution

The morphological features that differentiate the two subspecies of *B. knysnaensis* are attributed to environmental factors. No modern specimens of *B. knysnaensis robusta* have been recovered, and the geographical distribution of the subspecies is restricted to water depths of 140–200 m in a narrow latitudinal range between 20° and 24°S, seaward of the modern mud belt to the west and north-west of Walvis Bay. Only two samples from this area contained *B. knysnaensis knysnaensis* (both relict), and in only one were both subspecies found together.

Family Cytherideidae Sars, 1925

Subfamily Neocytherideidinae Puri, 1957

Genus *Neocytherideis* Puri, 1952

This genus has world-wide distribution in shallow-water environments. Its taxonomic status has recently been reviewed by Athersuch (1982).

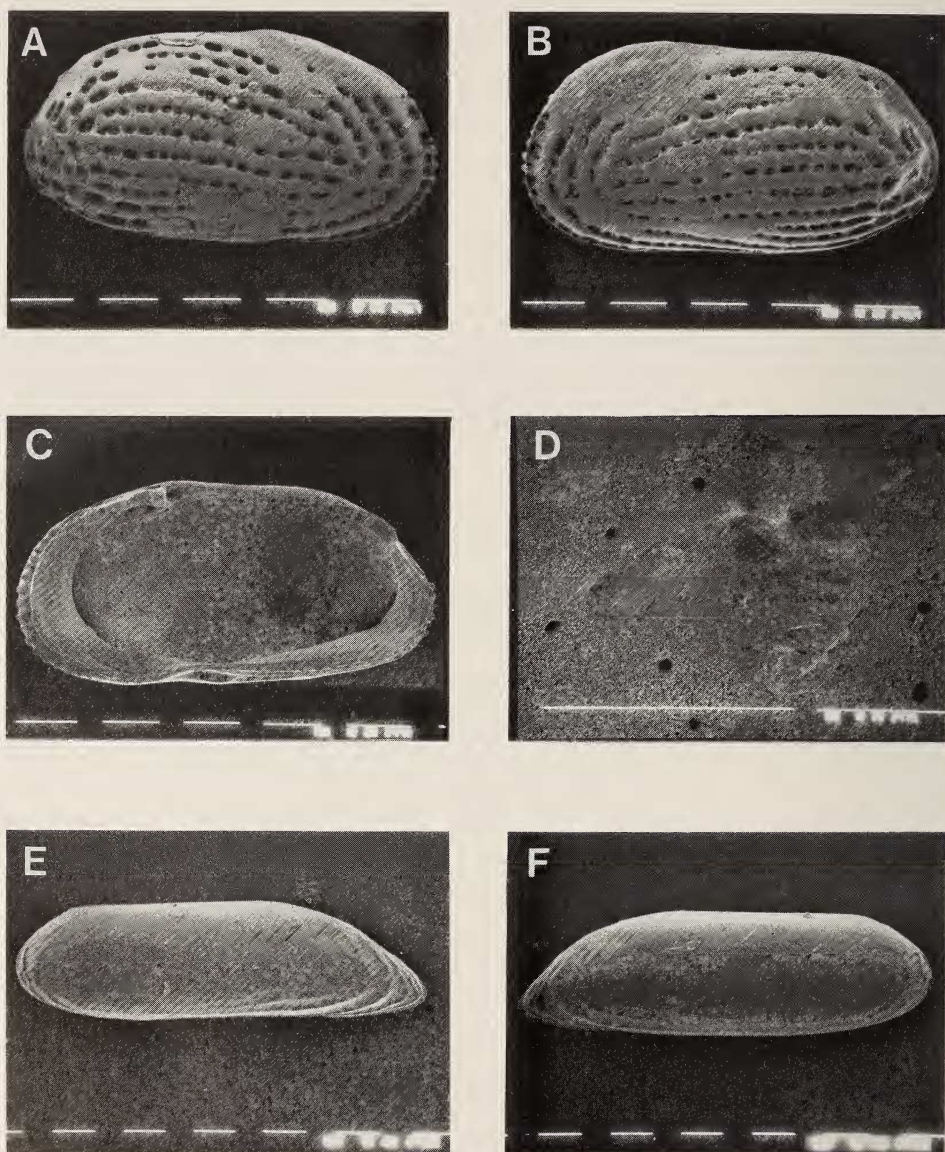


Fig. 19. A-D. *Bensonia knysnaensis robusta* subsp. nov., TBD 3792, 200 m. A. SAM-PQ-MF0533, RV, SEM 2467. B. SAM-PQ-MF0532, holotype, LV, SEM 2469. C-D. SAM-PQ-MF0534, RV. C. Internal view, SEM 2472. D. MS, SEM 2473. E-F. *Neocytherideis boomeri* sp. nov., TBD 6836, 80 m. E. SAM-PQ-MF0536, holotype, RV, SEM 2435. F. SAM-PQ-MF0537, LV, SEM 2433. Scale bars = 100 microns.

Neocytherideis boomeri sp. nov.

Figs 19E-F, 23A-D, 24

Neocytherideis sp. Keeler, 1981: 56-57, pl. 2 (fig. 19).*Copytus* sp. Boomer, 1985: 58-59, pl. 3 (fig. 43).*Derivation of name*

Named for Dr I. D. Boomer (University of East Anglia) who first noted the species off south-western Africa.

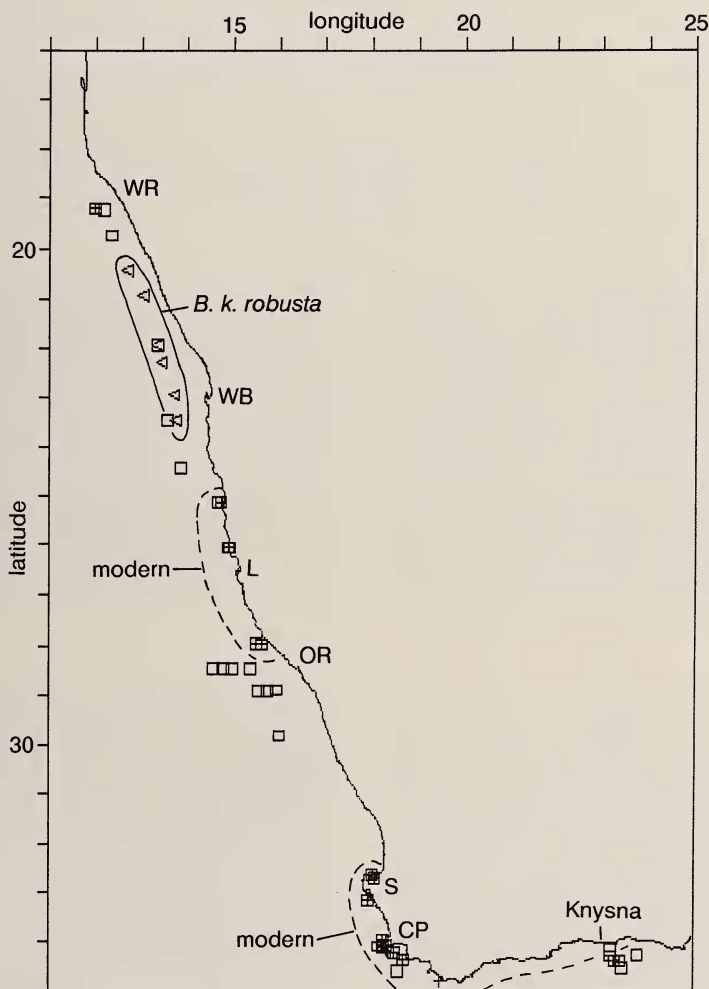


Fig. 20. Distribution of *Bensonia knysnaensis* (Benson & Maddocks, 1964). *B. k. knysnaensis* shown as squares (relict) and crosses (modern: dashed line is seaward extent); *B. k. robusta* subsp. nov. shown as triangles. See Fig. 7 for abbreviations.

Holotype

	length	height
SAM-PQ-MF-0536, RV, TBD 6836, 80 m	0,98 mm	0,28 mm

Paratypes

	length	height	width
SAM-PQ-MF-0537, LV, TBD 6836, 80 m	0,96 mm	0,29 mm	
SAM-PQ-MF-0538, LV, TBD 6836, 80 m	0,97 mm	0,29 mm	
SAM-PQ-MF-0539, RV, TBD 6836, 80 m	0,95 mm	0,27 mm	
SAM-PQ-MF-0540, C, TBD 6836, 80 m	1,00 mm	—	0,23 mm
SAM-PQ-MF-0541, RV, TBD 6847, 94 m			

Material

511 valves.

Diagnosis

Species with acuminate AM outline that is ventrally directed in RV, relatively strong narrow surface ridges sub-parallel to AM and PM, and a prominent fulcral point. The adductor MS lie on an elongate platform.

Description

External features. Elongate, cylindrical valves with strongly acuminate AM, particularly in the RV, where the line of greatest length is directed ventrally. PM is acutely rounded. Surface ornamentation consists of narrow ridges extending sub-parallel to the valve margins. These are most prominent anteriorly and posteriorly.

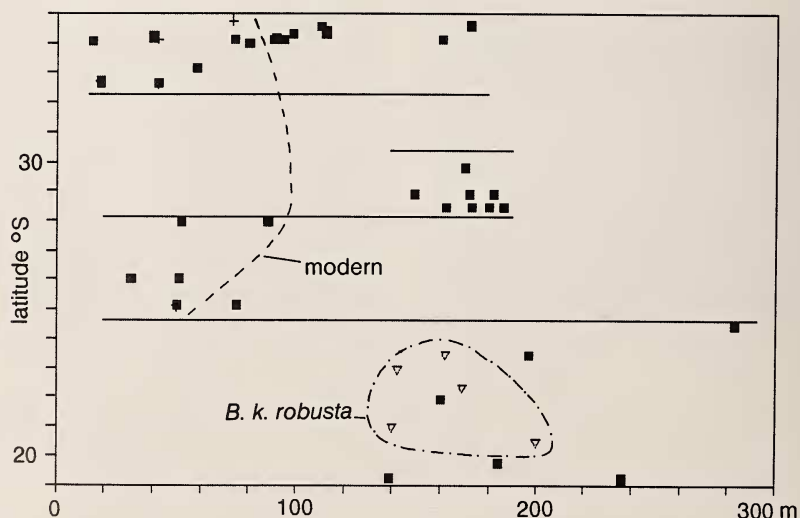


Fig. 21. Latitudinal water-depth distribution of sites with *Bensonia knysnaensis* (Benson & Maddocks, 1964). Horizontal lines delimit across-shelf populations. Crosses and dashed line = LDL of field with modern *B. k. knysnaensis*, triangles and dot-dashed line = field with *B. k. robusta* subsp. nov.

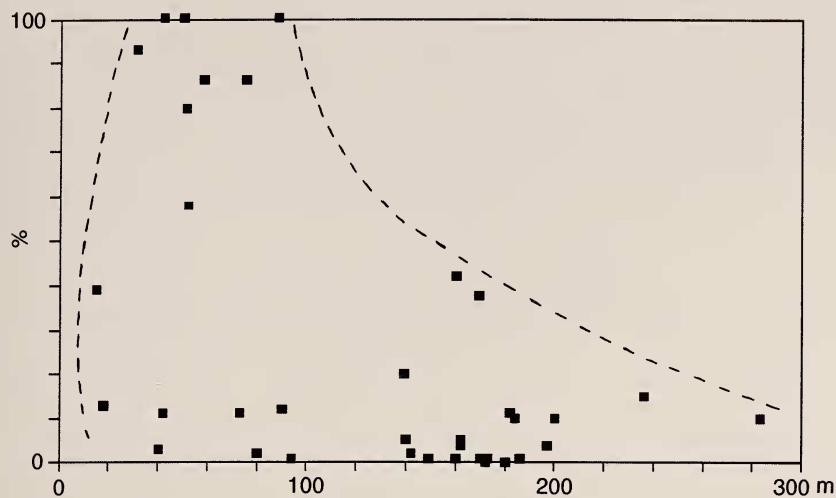


Fig. 22. Abundance of *Bensonia knysnaensis* (Benson & Maddocks, 1964) as percentage of ostracod fauna plotted against water depth.

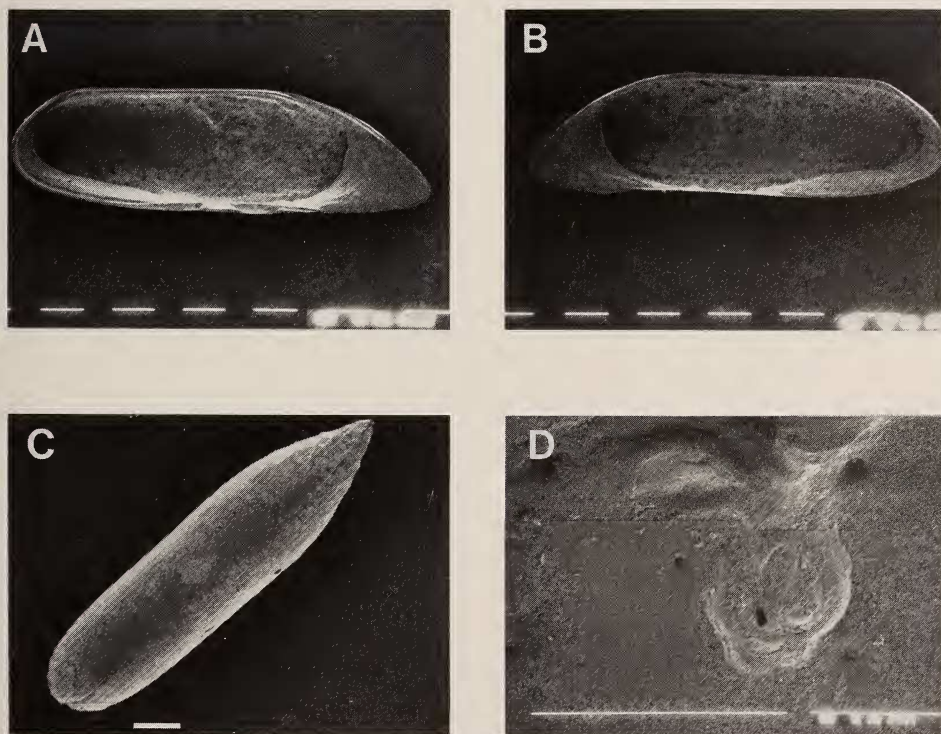


Fig. 23. A-D. *Neocytherideis boomeri* sp. nov., TBD 6836, 80 m. A. SAM-PQ-MF0538, LV, SEM 2443. B. SAM-PQ-MF0539, RV, SEM 2447. C. SAM-PQ-MF0540, carapace, dorsal view, SEM 2439. D. SAM-PQ-MF0539, RV, MS, SEM 2449. Scale bars = 100 microns.

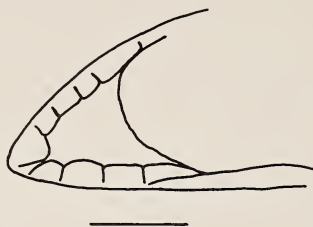


Fig. 24. *Neocytherideis boomeri* sp. nov., SAM-PO-MF0541, RV, detail of MA, TBD 6847, 94 m. Scale bar = 100 microns.

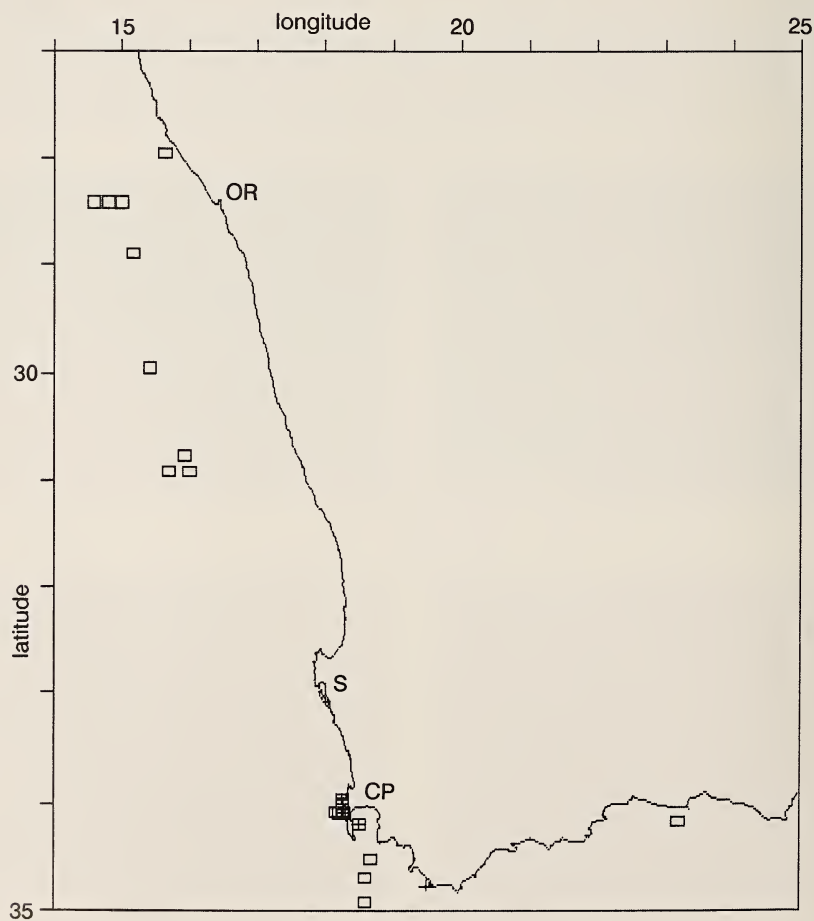


Fig. 25. Distribution of *Neocytherideis boomeri* sp. nov. Squares = relict sites; crosses = modern sites. See Fig. 7 for abbreviations.

Internal features. Normal pore canals are prominent, but their surface expression is faint. MA are broad anteriorly, with a wide triangular-shaped vestibulum, and moderately wide posteriorly and posteroventrally. There are approximately ten short, straight anterior radial pore canals. Hinge weakly lophodont. MS are prominent; adductors consist of a closely adjacent row of four, set on a raised platform that is linked to the prominent fulcral point by a ridge. The anterior scar is ovate and lies relatively far anterior to the adductors.

Remarks

Although species of *Neocytherideis* have been reported world-wide (Kemp 1986), the genus has until now not been formally recognized from the South Atlantic area. Two species of the related genus *Copys* have, however, been recorded from the south-western Atlantic and nearby Antarctic regions: *C. caligula* Skogsberg, 1939, and *C. elongatus* Benson, 1964 (e.g. Skogsberg 1939; Benson 1964; Neale 1967; Hartmann 1986). *Copys* does not occur off southern Africa but is widespread in the Australasian area, where *C. rara* McKenzie, 1967, occurs in the Eocene to Recent in Australia and New Zealand (McKenzie 1967; Swanson 1969). The two genera are distinguished by AM shape, and hinged.

Neocytherideis boomeri sp. nov. has all the generic characters, but its AM outline and surface ornamentation serve to distinguish it from previously described species of the genus. It is overall slimmer and more acuminate than the type (*N. subulata* (Brady, 1867)), and has a longer DM than *N. cypria* Athersuch, 1982, which lacks the posterior ornamentation of *N. boomeri*. The two species of *Neocytherideis* that have been recorded from the Southern Hemisphere (*N. mediata* Swanson, 1969—Miocene New Zealand; and *N. muelhenshardiae* Hartmann, 1982—Recent New Zealand) both differ from *N. boomeri* in ornamentation and AM outline.

A similar taxon is that illustrated by Hartmann (1978) from Willie Creek on the west coast of Australia as *Copys* aff. *C. rara* McKenzie, 1967. This specimen has a

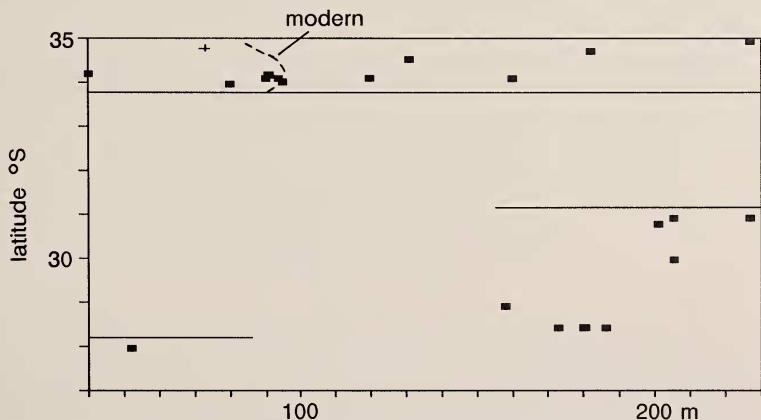


Fig. 26. Latitudinal water-depth distribution of sites with *Neocytherideis boomeri* sp. nov. Horizontal lines delimit across-shelf populations. Crosses and dashed line delimit LDL of modern fauna.

similar AM outline and surface ornamentation (somewhat more reticulate) to *N. boomeri*, but a different hinge and MS.

Distribution

Neocytherideis boomeri has been found on the continental shelf between Chamais Bay (28°S) and at least as far east as 23°E on the Agulhas Bank (Figs 25, 26). It was not recorded by Brady (1880), Klie (1940) or Hartmann (1974). Modern populations are confined to an inner shelf region between Hout Bay, False Bay and Quoin Point (19,3°E) on the south-western Cape coast in water depths between 40 m and 94 m. Here, modern valves make up between 2 and 100 per cent of the total *N. boomeri* assemblage. Relict populations occur in two regions. Between Chamais Bay and the Olifants River the species has UDL and LDL of 52 m and 227 m, whereas south of Hout Bay, the UDL and LDL are 40 m and 227 m, respectively. Although the populations in both areas have similar depth limits, their abundance distributions are different; the northern populations favour deeper water (>173 m), whereas in the south the species is most abundant in <100 m.

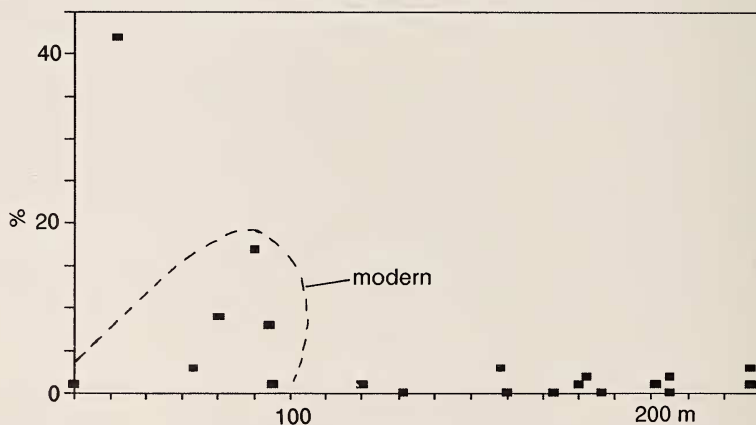


Fig. 27. Abundance of *Neocytherideis boomeri* sp. nov. as percentage of ostracod fauna plotted against water depth. Dashed line delimits modern fauna.

Family **Hemicytheridae** Puri, 1953

Subfamily Hemicytherinae Puri, 1953

Genus *Ambostracon* Hazel, 1962

The genus is interpreted in the sense of Valicenti (1977), who used the strength of the ocular ridge as a criterion for distinguishing between the two subgenera *Ambostracon* Hazel, 1962, and *Patagonacythere* Hartmann, 1962.

Three species of the genus occur off south-western Africa, all belonging to *A. (Ambostracon)*.

Subgenus *Ambostracon* (*Ambostracon*) Hazel, 1962*Ambostracon flabellicostata* (Brady, 1880)

Figs 28A–D, 29C, F

Cythere flabellicostata Brady, 1880: 88–89, pl. 1 (figs 6a–h). Puri & Hulings, 1976: 276–277, pl. 8 (figs 1–4).*Ambostracon* sp. B Keeler, 1981: 113–115, pl. 6 (figs 9–10).*Ambostracon* sp. D Keeler, 1981: 116–118, pl. 6 (figs 13–14).*Ambostracon* sp. 2 Boomer, 1985: 45–46, pl. 4 (figs 62, 65).*Ambostracon* (*Patagonacythere*) sp. A468 Frewin, 1987: 40, pl. 13A.*Illustrated material*

SAM–PQ–MF–0542, LV, TBD 2973, 173 m

SAM–PQ–MF–0543, RV, TBD 2973, 173 m

SAM–PQ–MF–0544, C, TBD 2224, 58 m

SAM–PQ–MF–0545, RV, TBD 2224, 58 m

Material

490 valves.

Remarks

In Brady's (1880) material, the strong ocular ridge crosses the eye tubercle and extends sub-parallel to the AM. In the anteroventral corner it curves and is continuous with a ventrolateral ridge. The SCT is prominent and joined to the anteroventral corner by a short ridge. The main features of the ornamentation and MS pattern are shown in Figure 29.

As Valicenti (1977, table 1) has shown, the genus is mainly represented in the South Atlantic–Antarctic area by species of *A. (Patagonacythere)*, and the only record of *A. (Ambostracon)* from the area outside southern Africa is from the Miocene of Argentina (*Ambostracon* (*A.*) sp. 1 Rossi de Garcia, 1970). This is a relatively elongate species with a prominent diagonal ridge extending between the posterodorsal and anteroventral corners. No records of the genus were made from the Tertiary of Gabon by Bold (1966), but Frewin (1987) has recorded two (possibly three) species from the Lower Tertiary of the Agulhas Bank. One of these (described as *A. (Patagonacythere)* sp. A468,) appears identical in ornamentation to *A. (A.) flabellicostata*, and occurs in a sample of Lower Palaeocene–Upper Eocene age (TBD 1275). A second specimen from the Upper Eocene (described as *Ambostracon* (*P.*) sp. B1457 by Frewin (1987) may be conspecific, but this has stronger ornamentation, and the dorsolateral rib pattern differs slightly from Brady's types.

Distribution

Brady (1880) recorded this species only from 'Challenger' Station 140 (30–40 m) in False Bay.

Modern specimens are restricted to nearshore sites off the south-western Cape between Saldanha Bay (33,16°S: 58 m) and Cape Agulhas (34,77°S: 73 m), where they have UDL and LDL of 15 m and 131 m, respectively (Fig. 30A). Keeler (1981) did not differentiate modern specimens from the eastern Agulhas Bank.

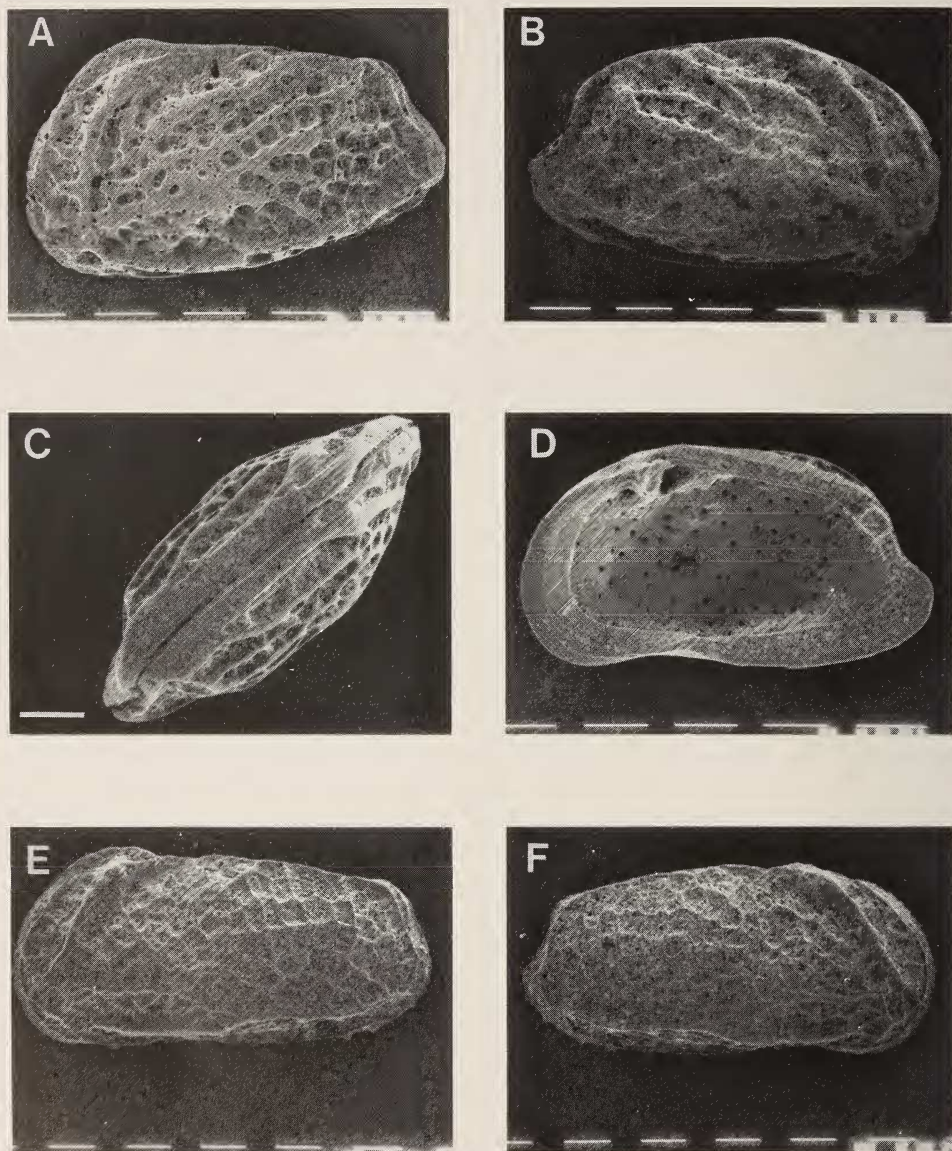


Fig. 28. A-D. *Ambostracon* (*A.*) *flabellcostata* (Brady, 1880). A. SAM-PQ-MF0542, LV, TBD 2973, 173 m, SEM 2515. B. SAM-PQ-MF0543, RV, TBD 2973, 173 m, SEM 2500. C. SAM-PQ-MF0544, carapace, dorsal view, TBD 2224, 58 m, SEM 2522. D. SAM-PQ-MF0545, RV, TBD 2224, 58 m, SEM 2516. E-F. *Ambostracon* (*A.*) *levetzovi* (Klie, 1940), TBD 3089, 18 m. E. SAM-PQ-MF0546, LV, SEM 2502. F. SAM-PQ-MF0547, RV, SEM 2505. Scale bars = 100 microns.

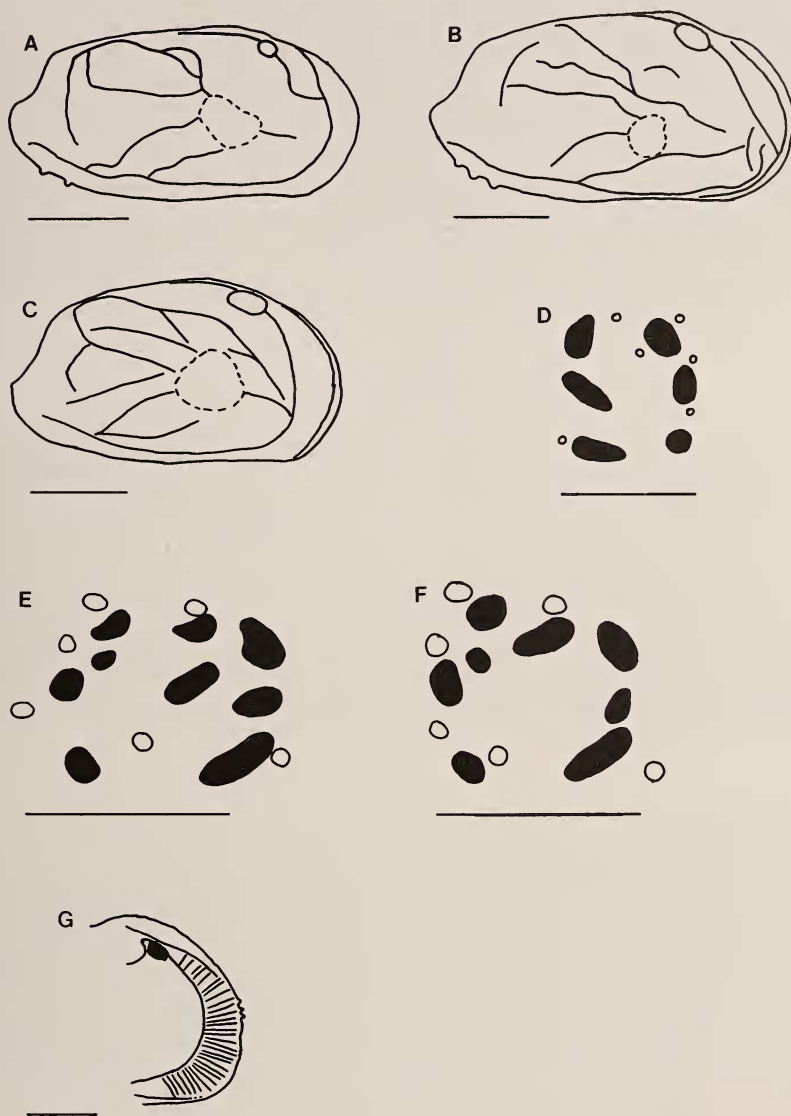


Fig. 29. *Ambostracon* (*Ambostracon*): comparison of three species. A-F. Main rib patterns of RV, and MS. A. *A. (A.) keeleri* sp. nov., SAM-PQ-MF0552, TBD 6823, 120 m. B. *A. (A.) levezovi* (Klie, 1940), SAM-PQ-MF0548, TBD 3089, 18 m. C. *A. (A.) flabellicostata* (Brady, 1880), SAM-PQ-MF0543, TBD 2973, 173 m. D. *A. (A.) keeleri* sp. nov., SAM-PQ-MF0555, LV, TBD 6835, 100 m. E. *A. (A.) levezovi* (Klie, 1940), SAM-PQ-MF0549, RV, TBD 3089, 18 m. F. *A. (A.) flabellicostata* (Brady, 1880), SAM-PQ-MF0545, RV, TBD 2224, 58 m. G. *A. (A.) keeleri* sp. nov., SAM-PQ-MF0556, LV, MA and radial pore canals, TBD 6823, 120 m. Scale bars: A-C, G = 200 microns; D-F = 100 microns.

Relict populations occur in a narrow zone between latitude 20,43°S and the eastern Agulhas Bank (Fig. 31A). Although this zone is widest on the Orange Shelf, it is here that abundances are lowest (<5%). Two continuous areas with relatively high abundances (>5%) lie along the coast: southern Namaqualand and south-western Cape, and the vicinity of Walvis Bay. Over the latitudinal range of relict specimens, the UDL falls into two well-defined groups: off Walvis Bay and on the Orange Banks they are 142 m and 158 m, respectively, whereas off Lüderitz and south-western Cape they are 31 m and 40 m, respectively (Fig. 32A). The latter values are similar to modern UDL. In all areas the LDL lies between 184 m and 223 m. Plotting abundance against water depth suggests that there is an abundance minimum between about 70 m and 90 m water depth off the south-western Cape (Fig. 33A).

Ambostracon (Ambostracon) levetzovi (Klie, 1940)

Figs 28E–F, 29B, E, 34A–C

Eucythereis levetzovi Klie, 1940: 419–421, figs 23–29.

Aurila levetzovi (Klie, 1940) Hartmann, 1974: 284, pl. 149 (fig. 7).

Illustrated material

SAM-PQ-MF-0546, LV, TBD 3089, 18 m

SAM-PQ-MF-0547, RV, TBD 3089, 18 m

SAM-PQ-MF-0548, RV, TBD 3089, 18 m

SAM-PQ-MF-0549, RV, TBD 3089, 18 m

SAM-PQ-MF-0550, LV, TBD 3089, 18 m

Material

19 valves.

Remarks

Klie (1940) and Hartmann (1974) both recorded this species on algae at inshore sites in Lüderitz Bay (no depth given). The present material is from one site (TBD 3089: 18 m) in St Helena Bay, along with relict and modern *A. (A.) keeleri* sp. nov. and relict *A. (A.) flabellcostata*. It is easily distinguished from the latter by the straightness and strength of the ocular ridge, and from *A. (A.) keeleri* by the fact that the ocular ridge crosses the eye tubercle.

Ambostracon (Ambostracon) keeleri sp. nov.

Figs 29A, D, G, 34D–F, 35A–B

Ambostracon sp. C Keeler, 1981: 115–116, pl. 6 (figs 11–12).

Ambostracon sp. E Keeler, 1981: 118–119, pl. 6 (figs 15–17).

Ambostracon sp. F Keeler, 1981: 119–120, pl. 6 (figs 18–19).

Ambostracon sp. 1 Boomer, 1985: 45–46, pl. 4 (figs 67–69).

Derivation of name

Named for Mr N. P. Keeler, formerly of University College of Wales, Aberystwyth, who first recovered the species.

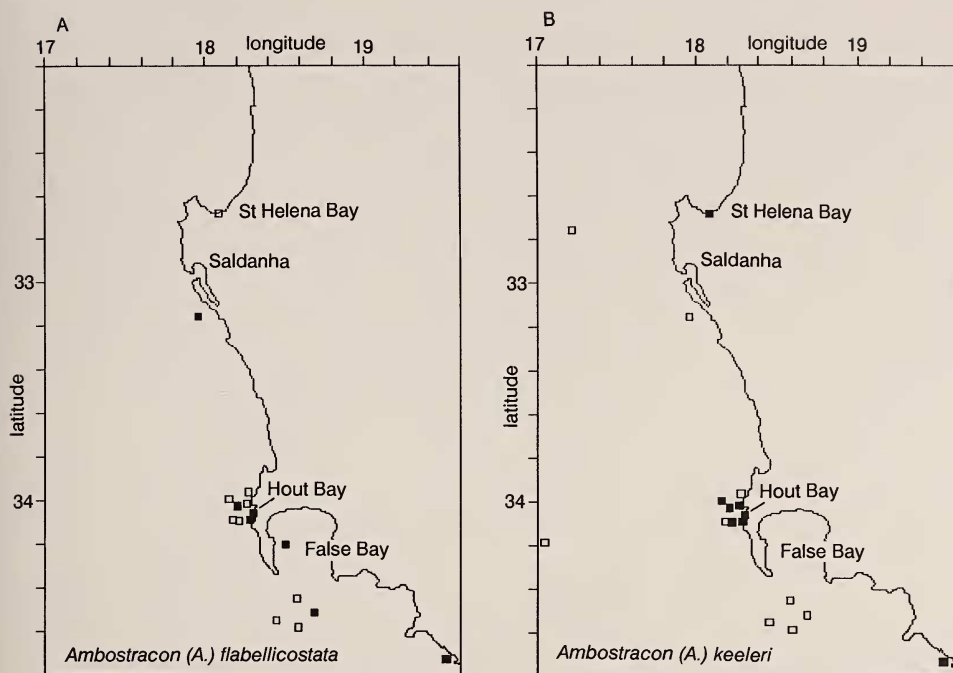


Fig. 30. Distribution of *Ambostracon* (*A.*) spp. off the south-western Cape. A. *A. (A.) flabellcostata* (Brady). B. *A. (A.) keeleri* sp. nov. Solid squares are modern sites.

Holotype

	length	height
SAM-PQ-MF-0551, LV, TBD 6823, 120 m	0,70 mm	0,38 mm

Paratypes

	length	height	width
SAM-PQ-MF-0552, RV, TBD 6823, 120 m	0,68 mm	0,33 mm	—
SAM-PQ-MF-0553, C, TBD 6823, 120 m	0,73 mm	—	0,30 mm
SAM-PQ-MF-0554, RV, TBD 6823, 120 m	0,68 mm	0,35 mm	—
SAM-PQ-MF-0555, LV, TBD 6835, 100 m	0,69 mm	0,38 mm	—
SAM-PQ-MF-0556, LV, TBD 6823, 120 m			

Material

1 024 valves.

Diagnosis

Species with a strong ocular ridge that runs anterior to the eye tubercle, and is not continuous with the ventrolateral ridge. Ribs radiate centrally from SCT.

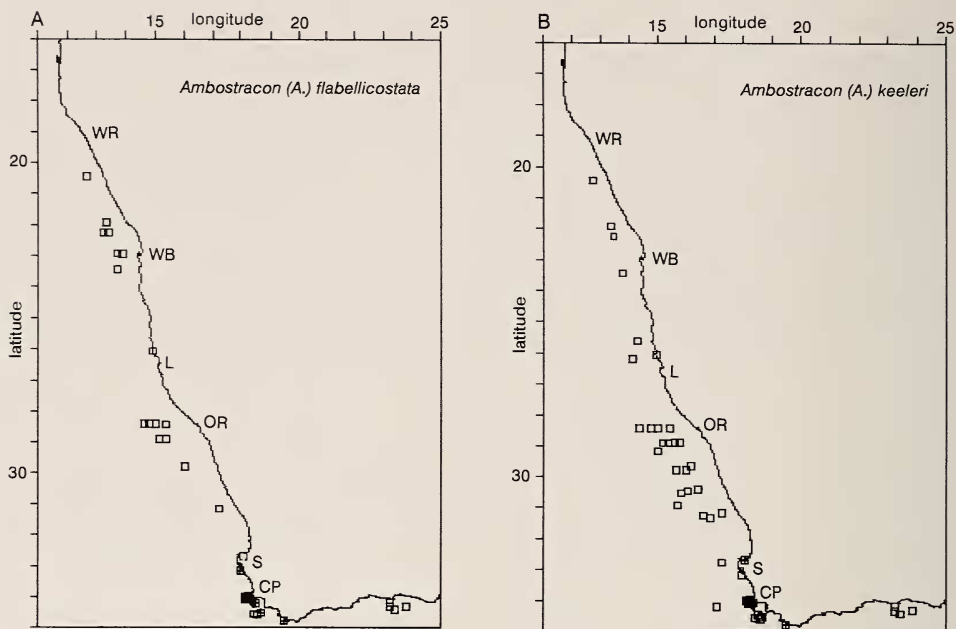


Fig. 31. Distribution of *Ambostracon (A.)* spp. A. *A. (A.) flabellcostata* (Brady). B. *A. (A.) keeleri* sp. nov. Squares = relict sites, crosses = modern sites. See Fig. 7 for abbreviations.

Description

External features. Sub-quadrate lateral outline, with males more elongate than females. AM has numerous small spines, PM has three short stout spines postero-ventrally. Central ornamentation consists of ribs radiating from a SCT with intercostal reticulation, and a semi-elliptical ridge in the posterodorsal area. Peripheral ribs consist of: a prominent, almost vertical rib that extends across the anterior area, and does not cross the eye tubercle, which it skirts anteriorly with a sickle-shaped deflection; a ventrolateral rib that runs from the PM and which, in the LV, abuts the anterior ridge, and in RV, is continuous with the anterior ridge; a thin rib that extends from the eye tubercle along the DM; and a curved rib that loops from a position near the SCT, via the posterodorsal shoulder down across the valve almost to the ventrolateral ridge. The eye tubercle is a large dome. In juveniles it is linked to the SCT by a prominent short curved rib.

Internal features. Typical of the genus. AM areas are avestibulate, with numerous (at least 30) straight, hair-like marginal pore canals. Hinge amphidont, with a prominently lobed PTE in the RV. MS could not be clearly seen, despite the large number of specimens available. They appear to be simpler than those in *A. flabellcostata* and *A. levezovi*, with a total of six scars (Fig. 29D).

Remarks

Ambostracon (A.) keeleri is easily distinguished from *A. (A.) flabellcostata*, with which it usually co-occurs, by the difference in AM ridge pattern (see Fig. 29).

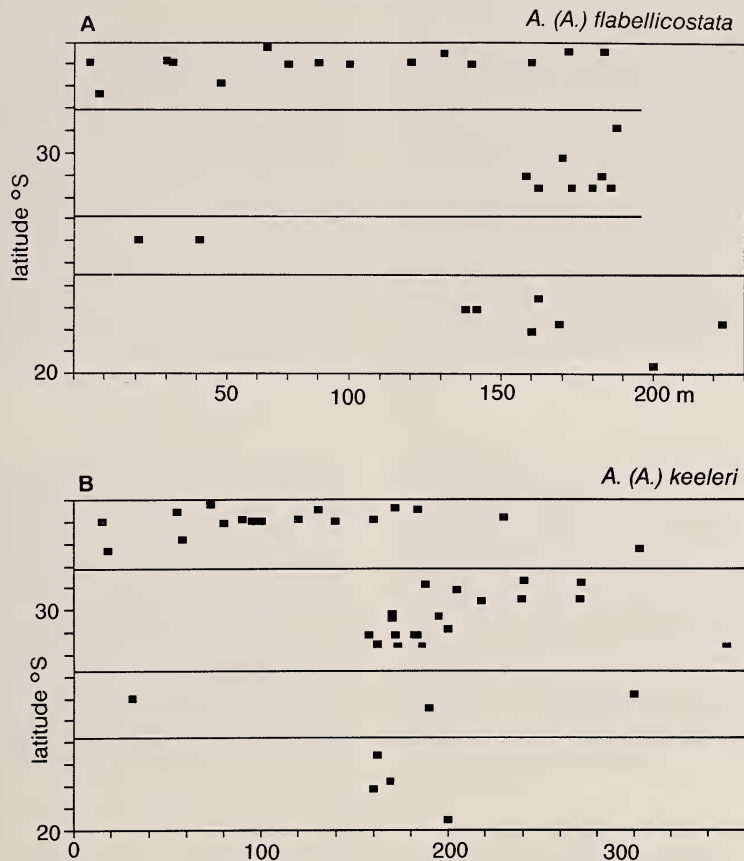


Fig. 32. Latitudinal water-depth distribution of sites with *Ambostracon* (A.) spp. Horizontal lines delimit cross-shelf populations. A. *A. (A.) flabellucostata* (Brady, 1880). B. *A. (A.) keeleri* sp. nov.

Ambostracon (A.) sp. A463 Frewin, 1987, from the Upper Palaeocene–Lower Eocene of the Agulhas Bank has a similar ocular rib to *A. (A.) keeleri*, but a different central area ornamentation, which is closer to that of *A. (A.) flabellucostata*.

Its closest relative is probably *A. (A.) longiducta* (Skogsberg, 1928), which also has a similar ocular rib that is deflected anterior to the eye tubercle. The two species differ in the course of the ocular rib, which is parallel to the AM margin in *A. (A.) longiducta*; in the disposition of ribs posterodorsally and in *A. (A.) longiducta* being somewhat plumper in outline. The latter species has been reported from various localities in Antarctica and the Subantarctic area: Ross Sea, 57 m (Benson 1964); Bransfield Strait, 133 m (Hartmann 1986, 1987); and South Georgia, 12–52 m (Skogsberg 1928).

Distribution

Modern specimens of *A. (A.) keeleri* are confined to nearshore sites off the southwestern Cape between an isolated occurrence in St Helena Bay (32,68°S: 18 m) and

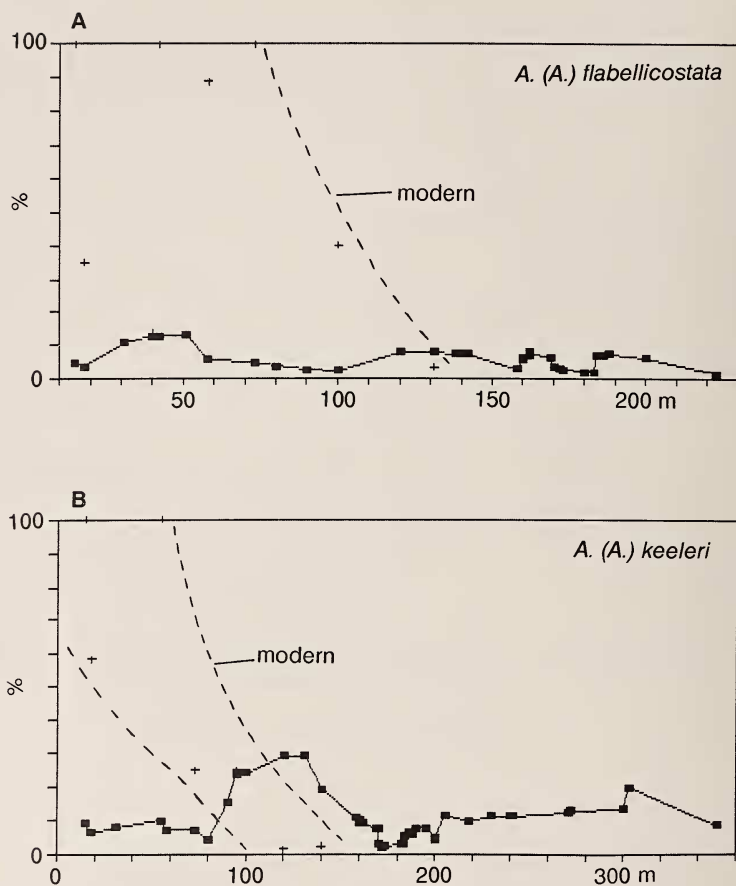


Fig. 33. Abundance of *Ambostracon* (*A.*) spp. as percentage of ostracod fauna plotted against water depth. Dashed lines = LDL (A), and UDL and LDL (B) of modern faunas. A. *A. (A.) flabelllicostata* (Brady, 1880). B. *A. (A.) keeleri* sp. nov.

Cape Agulhas (34,77°S: 73 m). The main concentration of samples lies off Hout Bay on the Cape Peninsula. UDL and LDL are 15 m and 140 m, respectively (Fig. 30B).

Relict specimens are recorded between latitude 20,43°S and the eastern Agulhas Bank (Fig. 31B). A narrow zone of relatively high abundance (>5% total ostracod fauna) stretches from the south-western Cape, to the vicinity of Lüderitz (25,6°S), where it forms a broader zone on the mid-shelf. A further narrow zone lies between 20,43°S and 23,43°S on the Walvis shelf. Over the latitudinal range of the relict specimens, UDL falls into two well-defined groups: off Walvis Bay and on the Orange Banks they are 160 m and 158 m, respectively, whereas off Lüderitz and south-western Cape they are 31 m and 15 m, respectively (Fig. 32B). The latter values are similar to those for modern UDL. Off the Walvis Shelf the LDL is at 200 m, whereas in all the southern areas the LDL lies between 252 m and 303 m. Plotting abundance against water depth suggests that there is an abundance peak between 90 m and 160 m water depth off the south-western Cape (Fig. 33B).

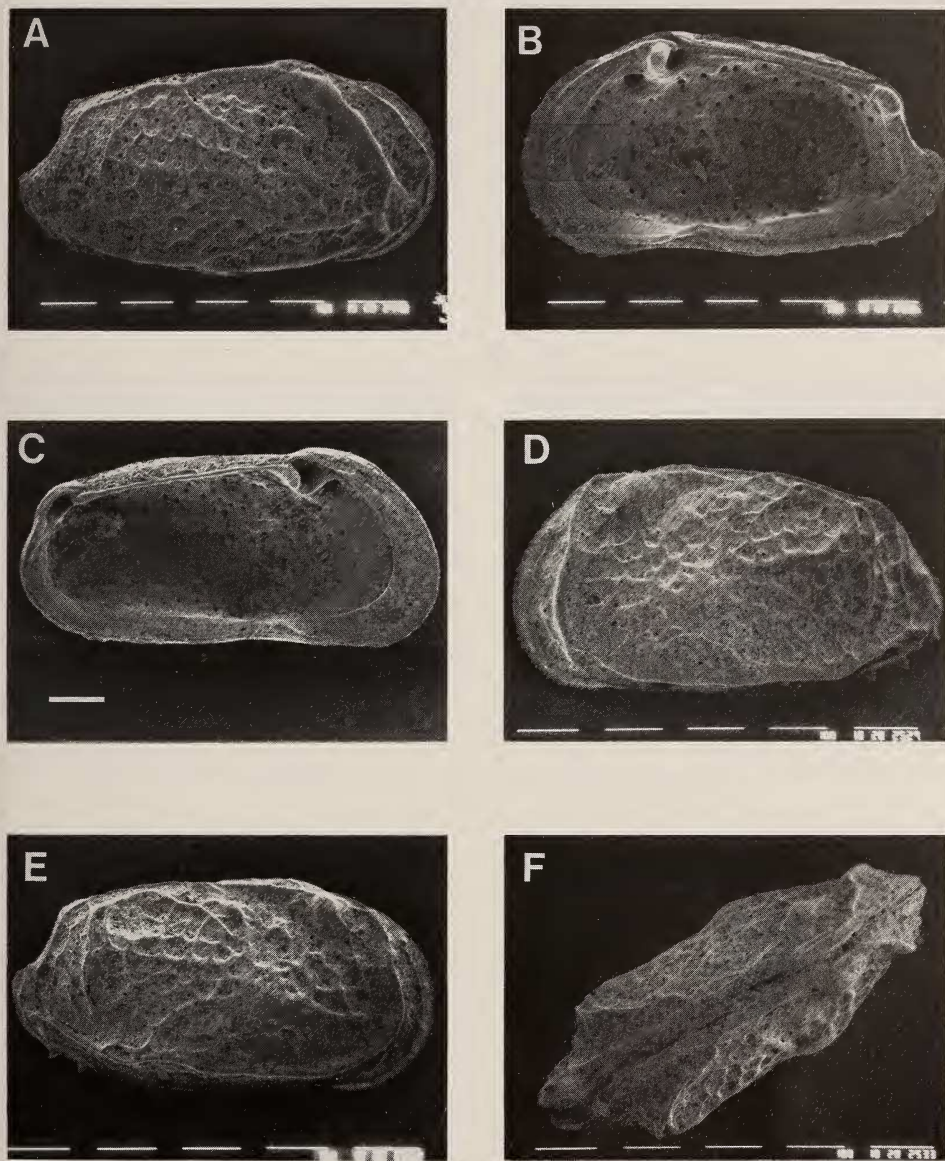


Fig. 34. A-C. *Ambostracon (A.) levetzovi* (Klie, 1940), TBD 3089, 18 m. A. SAM-PQ-MF0548, RV, SEM 2498. B. SAM-PQ-MF0549, RV, SEM 2506. C. SAM-PQ-MF0550, LV, SEM 2525. D-F. *Ambostracon (A.) keeleri* sp. nov., TBD 6823, 120 m. D. SAM-PQ-MF0551, holotype, LV, SEM 2529. E. SAM-PQ-MF0552, RV, SEM 2532. F. SAM-PQ-MF0553, carapace, dorsal view, SEM 2533. Scale bars = 100 microns.

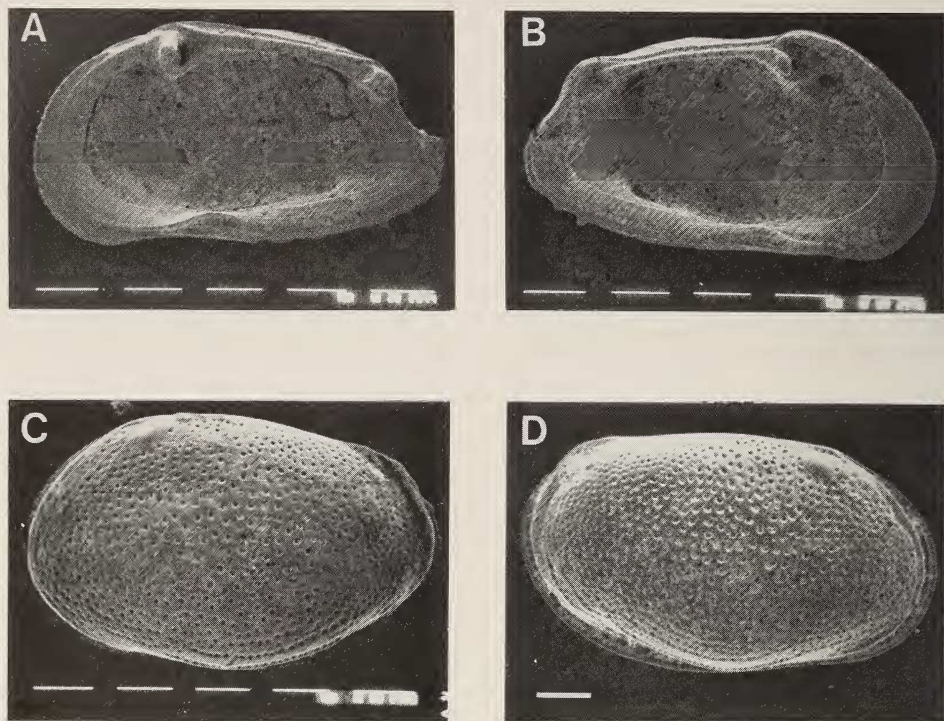


Fig. 35. A–B. *Ambostracon* (*A.*) *keeleri* sp. nov. A. SAM-PQ-MF0554, RV, TBD 6823, 120 m, SEM 2544. B. SAM-PQ-MF0555, LV, TBD 6835, 100 m, SEM 2540. C–D. *Palmoconcha walvisbaiensis* (Hartmann, 1974), TBD 3940, 184 m. C. SAM-PQ-MF0562, LV, SEM 2420. D. SAM-PQ-MF0563, RV, SEM 2417. Scale bars = 100 microns.

Summary of the distribution of the genus Ambostracon

Ambostracon (*A.*) *flabellcostata* and *A.* (*A.*) *keeleri* have very similar distribution patterns, particularly for modern specimens, where they are both confined to the south-western Cape (Fig. 4), and best developed off the middle part of the Cape Peninsula in almost identical depths: 15–131 m and 15–140 m, respectively.

There are subtle differences in their relict distributions. *A.* (*A.*) *keeleri* is best developed in a more or less continuous zone from the south-western Cape to the vicinity of Lüderitz, with the Walvis Shelf populations relatively sparse. In contrast, *A.* (*A.*) *flabellcostata* is best developed off the south-western Cape and on the Walvis shelf, with only a relatively sparse representation on the Namaqualand–Orange shelves. Both species show a very similar latitudinal UDL variation, with the areas off the Walvis and Orange shelves having values *c.* 100 m deeper than areas to the north and south. Regionally, relict *Ambostracon* faunas are an important component of the ostracod populations at the northern end of the Cape Peninsula, and immediately south of Walvis Bay (Fig. 5).

Depth versus percentage plots (Fig. 33) suggest that *A.* (*A.*) *keeleri* prefers mid-shelf environments (*c.* 120 m), whereas *A.* (*A.*) *flabellcostata* has peaks in the near-

shore (c. 40 m) and mid- to outer-shelf (c. 130–200 m) zone. *Ambostracon* (*A.*) *levetzeri* is confined to coastal and inshore sites between Lüderitz and St Helena Bay.

Family *Loxoconchidae* Sars, 1925

Taxonomically the family *Loxoconchidae* is complex. It has a relatively long geological history (late Cretaceous to Recent) and the various genera within it have world-wide distribution. The generic classification followed here is an emended version of that discussed by Athersuch & Horne (1984).

The family is relatively well-represented in the Quaternary around southern Africa with 12 species, eight of which occur off the south-western and southern coasts (Fig. 36):

Loxoconcha megapora Benson & Maddocks, 1964. Reported from Knysna Lagoon (Leisure Island—Benson & Maddocks 1964), whereas the variety *L. megapora magna* occurs at Lüderitz and Kommetjie (Cape Peninsula—Hartmann 1974).

L. parameridionalis Benson & Maddocks, 1964. Reported from Knysna Lagoon, associated with sandy substrates with *Zostera* and a maximum salinity of 30‰ (Benson & Maddocks 1964; Hartmann 1974).

Australoloxoconcha favornamentata Hartmann, 1974. A subtropical coastal species living on fine sand substrates. Reported from coastal sites at Knysna, St Lucia, and Maputo.

Australoloxoconcha parafavornamentata Hartmann, 1974. Reported only from Knysna Lagoon.

Palmoconcha walvisbaiensis (Hartmann, 1974). Reported from coastal and inner shelf areas, Walvis Bay to south of Lüderitz.

Palmoconcha? walvisridgensis sp. nov. An inner shelf species reported only from the Walvis Ridge abutment area.

Palmoconcha subrhomboidea (Brady, 1880). An inner shelf species reported between the Cape Peninsula and eastern Agulhas Bank.

Kuiperiana angulata sp. nov. An outer-inner shelf species reported from the Walvis Ridge Shelf to south of the Cape Peninsula.

Fossil representatives of the family from south-western Africa have been reported from the Agulhas Bank (4 species, Palaeocene–Eocene—Frewin 1987), the Natal off-

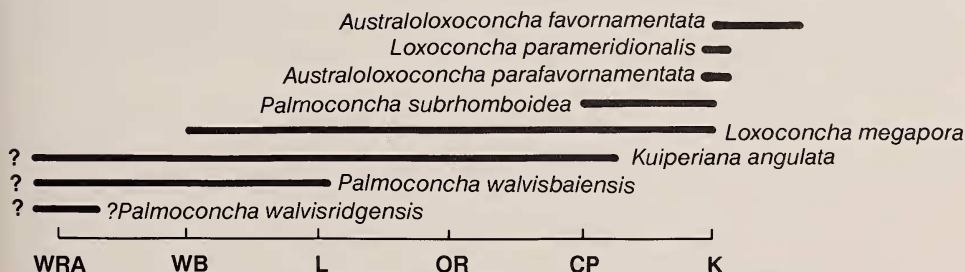


Fig. 36. Distribution of coastal and shelf species of the family *Loxoconchidae* around south-western Africa. Abbreviations: WRA—Walvis Ridge abutment shelf; WB—Walvis Bay; L—Lüderitz; OR—Orange River; CP—Cape Peninsula; K—Knysna.

shore (1 species, Oligocene—Dingle 1976), and Gabon (2 species, Mio-Pliocene—Bold 1966).

Genus *Palmoconcha* Swain & Gilby, 1974

This genus is distinguished by its gongyodont hinge with smooth ME, its Y-shaped anterior MS and a fulcral point adjacent to the second or third adductor scar (Swain & Gilby 1974; Horne & Kilenyi 1981; Athersuch & Horne 1984). Its known geographical range is Europe (including the Mediterranean and Black seas), the east and west coasts of North America, and the south-east Atlantic.

Palmoconcha walvisbaiensis (Hartmann, 1974)

Figs 35C–D, 37A–E

Loxoconcha walvisbaiensis Hartmann, 1974: 297–298, pl. 65 (figs 488–497). Boomer, 1985: 54–56, pl. 1 (figs 14–15).

non *Loxoconcha* cf. *L. walvisbaiensis* Hartman, 1974. Frewin, 1987: 50, pl. 14 (fig. G).

Illustrated material

SAM–PQ–MF–0562, LV, TBD 3940, 184 m

SAM–PQ–MF–0563, RV, TBD 3940, 184 m

SAM–PQ–MF–0564, RV, TBD 3926, 236 m

SAM–PQ–MF–0565, LV, TBD 3926, 236 m

Hamburg University Catalogue No. K30069, LV, Walvis Bay.

Material

475 valves.

Remarks

The smooth ME of the hinge, the Y-shaped anterior MS, and the position of the fulcral point allow me to confidently re-assign Hartmann's species to the genus *Palmoconcha*.

Frewin's (1987) record of *Loxoconcha* cf. *L. walvisbaiensis* Hartmann, 1974, is not conspecific with Hartmann's species, and possibly belongs in the genus *Saida*.

Distribution

This species was originally recorded by Hartmann (1974) from Walvis Bay lagoon. Our study has shown it to be confined to areas north of about 26°S (Fig. 38) and, although there are no precise data on its northern latitudinal range, Hartmann (1974) did not record it from Moçamedes (15°S: Angola).

Modern populations of *Palmoconcha walvisbaiensis* occur from north of the Walvis Ridge shelf (17,5°S) to just south of Walvis Bay (c. 24°S), where the UDL and LDL are 15 m and 236 m, respectively (Fig. 39).

Relict populations extend 2 degrees farther south (to just north of Lüderitz) but the depth range is similar to that for the modern specimens (31–280 m).

In a high percentage of cases, this species is the only ostracod recovered from the sample in which it occurs (10 of 30 sites), whereas in 22 out of 30 it constitutes >50 per cent of the total ostracod assemblage. Although absent from within the main

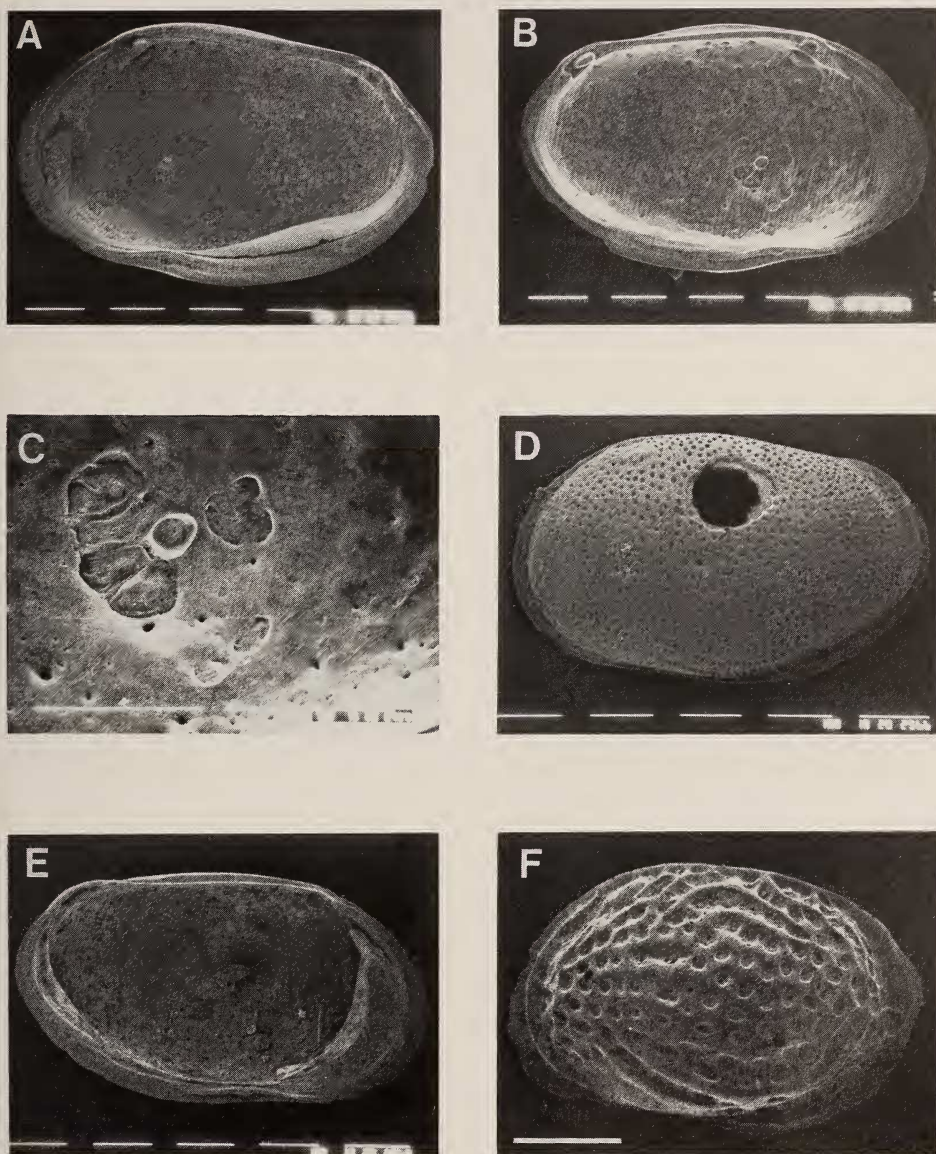


Fig. 37. A-E. *Palmoconcha walvisbaiensis* (Hartmann, 1974). A-C. TBD 3926, 236 m. A. SAM-PQ-MF0564, RV, SEM 2428. B-C. SAM-PQ-MF0565, LV. B. Internal view, SEM 2421. C. MS, SEM 2423. D. Paratype, Hamburg University catalogue slide No. K30069, LV, Walvis Bay, SEM 2566. E. Paratype, Hamburg University catalogue slide No. K30069, LV, Walvis Bay, SEM 2568. F. *Palmoconcha subrhomboidea* (Brady, 1880), SAM-PQ-MF0568, LV, TBD 5254, 40 m, SEM 2965. Scale bars = 100 microns.

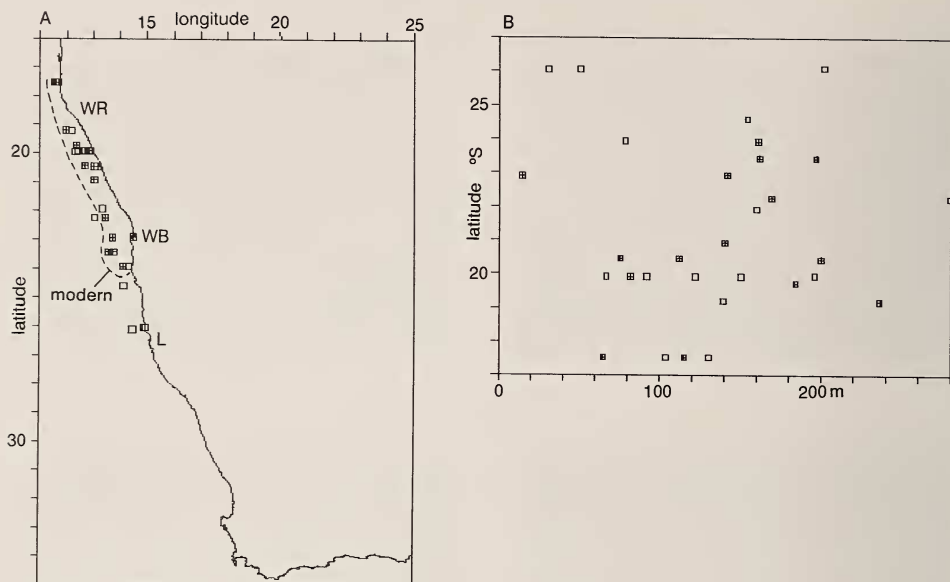


Fig. 38. A. Distribution of *Palmoconcha walvisbaiensis* (Hartmann, 1974). Squares = relict sites, crosses = modern sites (seaward and southward extent shown by dashed line). See Fig. 7 for abbreviations. B. Latitudinal water-depth distribution of sites with *P. walvisbaiensis* (Hartmann, 1974). Squares—relict sites, crosses—modern sites.

diatomaceous mud belt, this species seems relatively tolerant of oxygen-depleted water, in which ostracod assemblages are generally sparse and of low diversity. In addition, its southward modern limit lies in the vicinity of the maximum southerly intrusion of warm, saline Angola Current water (e.g. Shannon 1985).

Palmoconcha? walvisridgensis sp. nov.

Figs 40B, 41B–C

?*Loxoconcha* sp. aff. *L. australis* Brady, 1880. Bold, 1966: 170, pl. 3 (fig. 6).

Derivation of name

Named for the type locality of the species, the Walvis Ridge abutment shelf.

Holotype

	length	height
SAM-PQ-MF-0566, C, TBD 3888, 154 m	0,50 mm	0,30 mm

Paratype

	length	height
SAM-PQ-MF-0567, C, TBD 3972, 200 m	0,50 mm	0,30 mm

Material

5 valves.

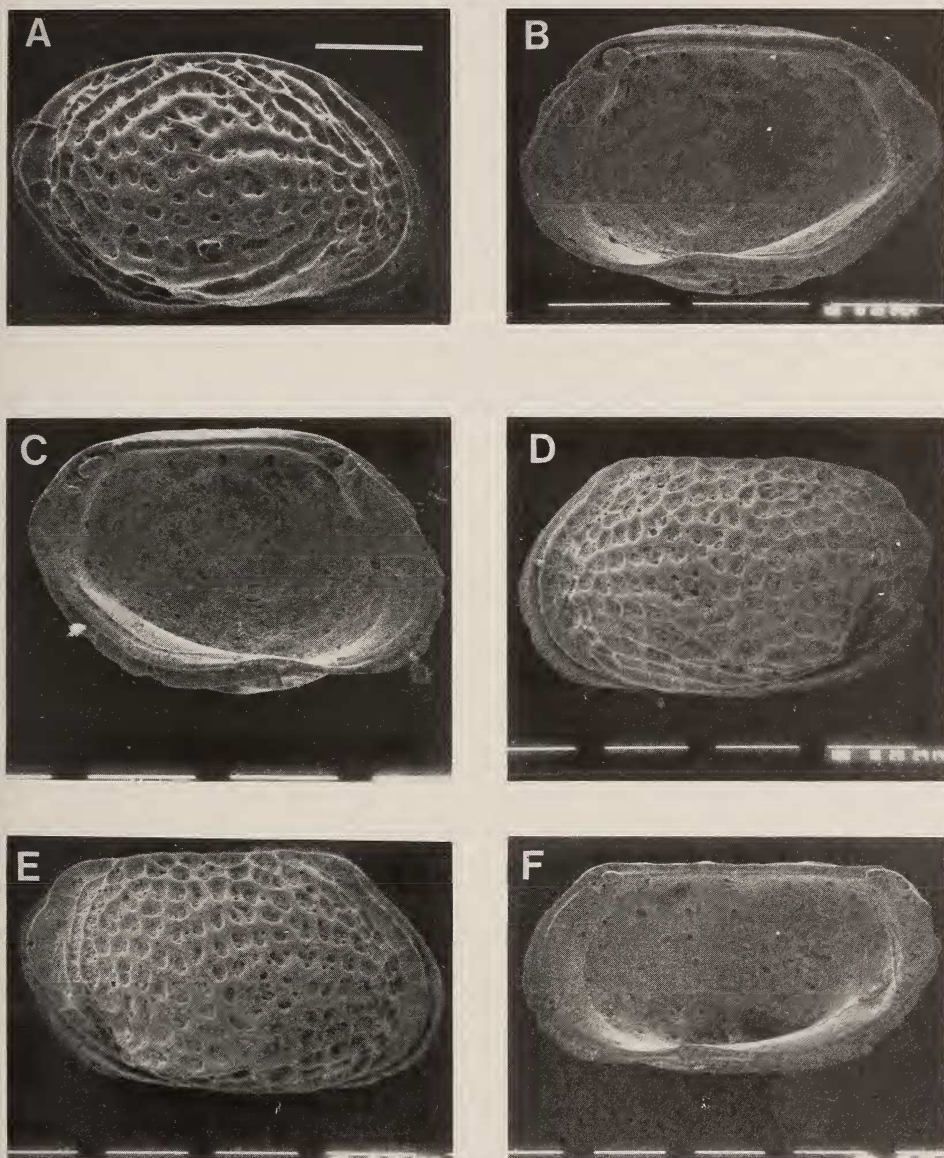


Fig. 39. A-C. *Palmoconcha subrhomboidea* (Brady, 1880), TBD 5254, 40 m. A. SAM-PQ-MF0569, RV, SEM 2968. B. SAM-PQ-MF0570, RV, SEM 2969. C. SAM-PQ-MF0571, LV, SEM 2962. D-F. *Kuiperiana angulata* sp. nov. D. SAM-PQ-MF0572, holotype, LV, TBD 2924, 158 m, SEM 2919. E. SAM-PQ-MF0573, RV, TBD 3587, 140 m, SEM 2916. F. SAM-PQ-MF0574, RV, TBD 3524, 475 m, SEM 2923. Scale bars = 100 microns.

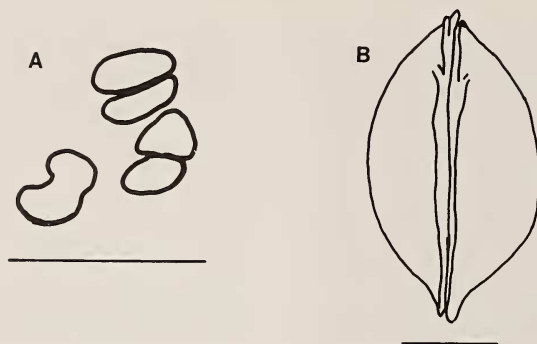


Fig. 40. A. *Kuiperiana angulata* sp. nov., SAM-PQ-MF0576, RV, MS, TBD 2974, 186 m. B. *Palmoconcha? walvisridgensis* sp. nov., SAM-PQ-MF0566, holotype, carapace, dorsal outline, TBD 3888, 154 m. Scale bars: A = 100 microns, B = 200 microns.

Diagnosis

Species with asymmetrically rounded, ventrally directed AM outlines, straight DM, and two strong, curved ventrolateral ribs.

Description

External features. Elongate ovate lateral outline. Broad, asymmetrically rounded AM with wide rims, ventrally directed. PM rounded, semi-caudate, with apex dorsally directed. DM straight, with a small step at the anterior cardinal angle. VM slightly convex, partly obscured by lateral surface overhang. Surface strongly reticulate, with two curved, sub-parallel ribs on ventrolateral surface. Reticulation is coarsest in sub-central areas.

No internal features were observed in specimens that were either poorly preserved, or carapaces.

Remarks

Palmoconcha? walvisridgensis is probably conspecific with the taxon recorded from the Pliocene of Gabon by Bold (1966) as *Loxoconcha* aff. *L. australis* Brady. The specimen illustrated in Bold (1966, pl. 3 (fig. 6)) appears to be somewhat abraded and consequently has less robust surface ornamentation than my material, but its overall valve shape and reticulation pattern is very similar. The lectotypes of *L. australis* Brady, 1880, as illustrated by Puri & Hulings (1976, pl. 18 (figs 17–18), pl. 19 (figs 1–4)) show that *P.? walvisridgensis* differs from Brady's species in lacking the strong upward sweep of the posteroventral outline, and in the outline of the postero-dorsal margin, which is more acuminate in our species. In addition, *L. australis* has a distinct posterodorsal hinge ear that gives the posterior end of the DM outline a slight concavity.

An Indo-Pacific species that has a similar outline and ornamentation to *P.? walvisridgensis* is *Loxoconcha paiki* Whatley & Quanhong, 1987, from the Persian Gulf–Malacca Straits region. This differs from my species in the outline of the antero-

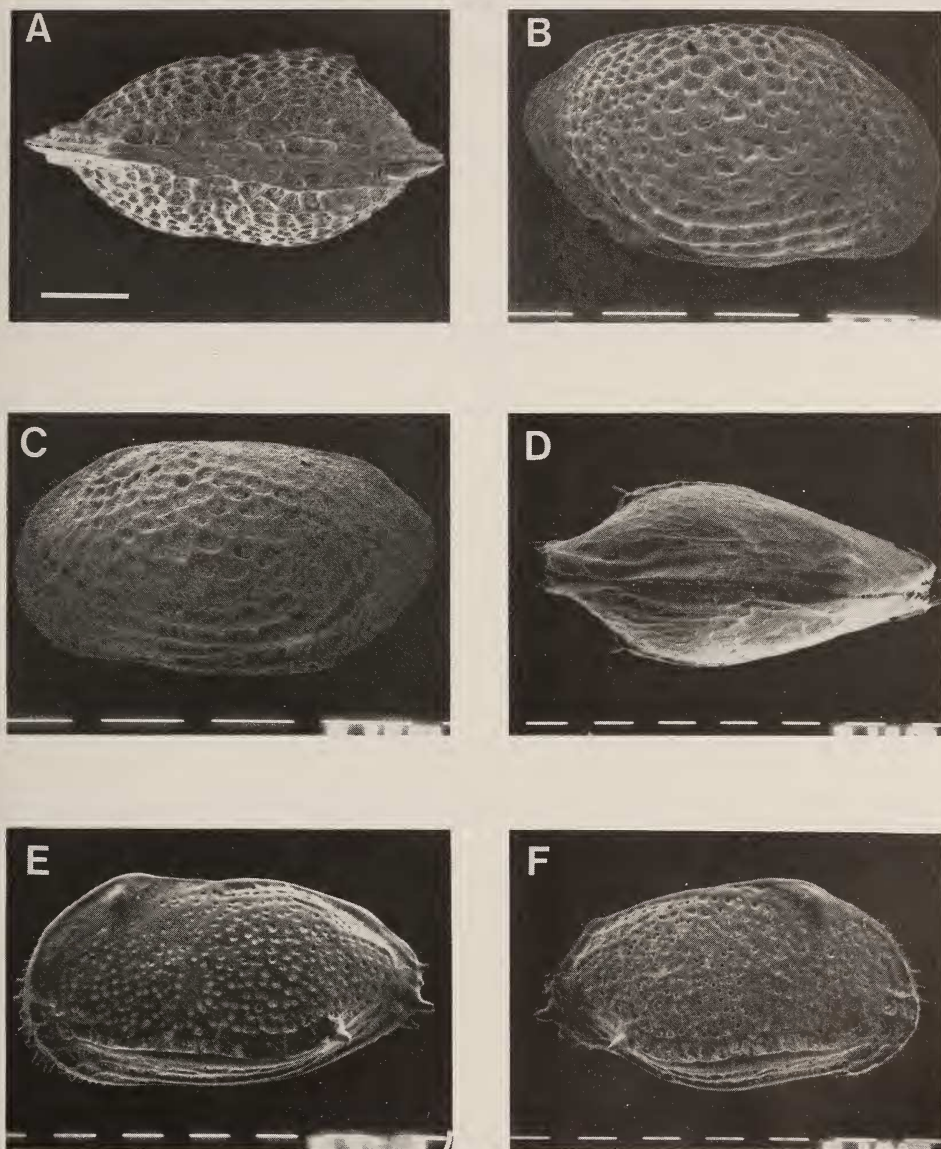


Fig. 41. A. *Kuiperiana angulata* sp. nov., SAM-PQ-MF0575, carapace, dorsal view, TBD 2924, 158 m, SEM 2920. B-C. *Palmoconcha? walvisridgensis* sp. nov. B. SAM-PQ-MF0566, holotype, carapace, right view, TBD 3888, 154 m, SEM 2972. C. SAM-PQ-MF0567, carapace, left view, TBD 3972, 200 m, SEM 2973. D-F. *Ruggieria cytheropteroides* (Brady, 1880). D. SAM-PQ-MF0588, carapace, dorsal view, TBD 2472, 201 m, SEM 2426. E. SAM-PQ-MF0589, LV, TBD 2975, 180 m, SEM 2403. F. SAM-PQ-MF0590, RV, TBD 2975, 180 m, SEM 2399. Scale bars = 100 microns.

ventral area, and in its more strongly curved muri in the reticulum of the central valve area.

Distribution

Palmoconcha? walvisridgensis was found at three stations in the northernmost part of the study area: on the southern part of the Walvis Ridge abutment shelf (20,4°S) and to the north of the abutment on the narrow shelf at the southern end of the Angola Basin, just south of the Kunene River (17,5°S) (Fig. 42). Modern valves were recovered only from the latter area.

The depth range suggested by these sites is relatively narrow and deep (154–200 m) with the modern population occupying the shallower depth.

These data suggest that *P.? walvisridgensis* is a subtropical species that inhabits the middle to outer shelf.

Palmoconcha subrhomboidea (Brady, 1880)

Figs 37F, 39A–C

Loxoconcha subrhomboidea Brady, 1880: 121, pl. 28 (figs 4a–d). Puri & Hulings, 1976: 298–299, pl. 18 (figs 15–16).

Loxoconcha sp. B Keeler, 1981: 143–154, pl. 8 (figs 10–11).

Loxoconcha sp. B192 Frewin, 1987: 46–47, pl. 16A–F, text-fig. 2.11A.

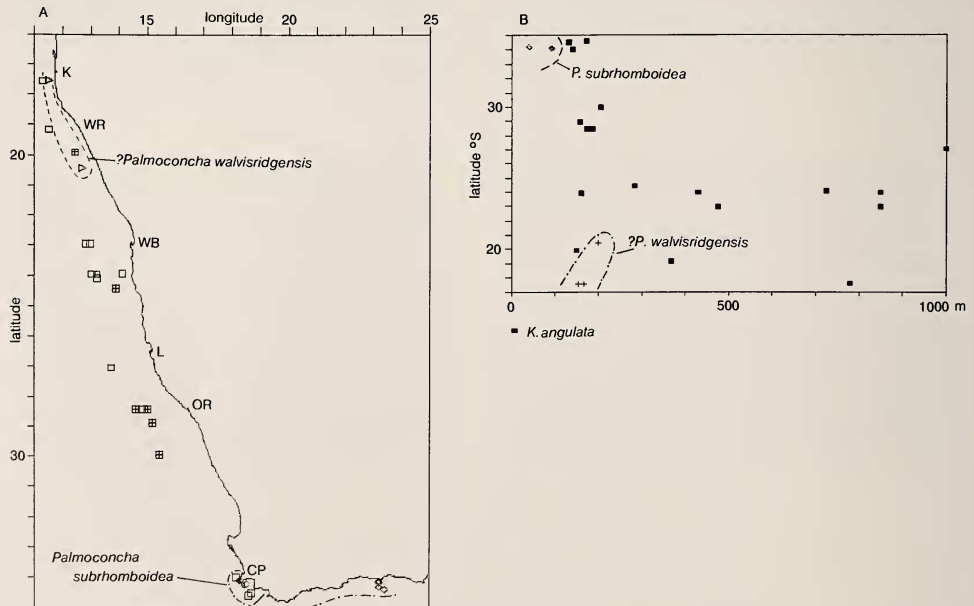


Fig. 42. A. Distribution of *Palmoconcha? walvisridgensis* sp. nov. (triangles, dashed line shows extent), *Kuiperiana angulata* sp. nov. (squares = relict sites, solid line south-east of Cape Peninsula shows southern extent; crosses = modern sites), and *Palmoconcha subrhomboidea* (Brady, 1880) (diamonds, dot-dashed line shows seaward extent). See Fig. 7 for abbreviations. B. Latitudinal water-depth distribution of sites with *P. subrhomboidea* (Brady, 1880) (triangles), *K. angulata* sp. nov. (solid squares), and *P.? walvisridgensis* sp. nov. (crosses).

Illustrated material

SAM-PQ-MF-0569, RV, TBD 5254, 40 m

SAM-PQ-MF-0570, RV, TBD 5254, 40 m

SAM-PQ-MF-0571, LV, TBD 5254, 40 m

Material

39 valves.

Remarks

The characteristic features of this species are a strong, curved, ventrolateral ridge and furrow, and a sharply arched dorsomedian rib. Its placement within *Palmoconcha* is not certain because no unequivocal views of the MS were available.

Distribution

Brady (1880) found this species only at 'Challenger' Station 140 in 15–20 fm (27–37 m) in False Bay, and in the present study I have established that it does not extend farther north, having recorded it only from False Bay (40 m), and at two sites west of the Hout Bay area (90–94 m) (Fig. 42A–B). Modern specimens occur in False Bay and at 94 m off the western side of the Cape Peninsula, whereas relict valves occur in False Bay and at 90 m off the Peninsula. Its extension on to the Agulhas Bank, where Keeler (1981) noted it at four sites with a water depth range 65–112 m, indicates that *P. subrhomboidea* is a warm-water taxon. It is not known whether any of Keeler's (1981) material was from modern populations.

Frewin (1987) illustrated this species from Palaeogene (?Upper Palaeocene–Middle Eocene) sediments of the Agulhas Bank, where she recorded five valves. A similar (but not conspecific) species (*Loxoconcha* sp. A3243 Frewin, 1987: 48) occurs in Upper Eocene strata of the same area.

Genus *Kuiperiana* Bassiouni, 1962

This genus was erected by Bassiouni (1962) to differentiate species of *Loxoconcha* that possess a long DM and consequently a long hinge ME. Previous records of this genus have been confined to Oligocene–Miocene strata of north-western Europe (e.g. see Uffenorde 1981; Kempf 1986)

Kuiperiana angulata sp. nov.

Figs 39D–F, 40A, 41A

Derivation of name

Angularis—Latin = angular, reference to angular, truncated alae.

Holotype

	length	height
SAM-PQ-MF-0572, LV, TBD 2924, 158 m	0,48 mm	0,29 mm

Paratypes

	length	height	width
SAM-PQ-MF-0573, RV, TBD 3587, 140 m	0,50 mm	0,30 mm	—
SAM-PQ-MF-0574, RV, TBD 3524, 475 m	0,58 mm	0,29 mm	—
SAM-PQ-MF-0575, C, TBD 2924, 158 m	0,51 mm	—	0,25 mm
SAM-PQ-MF-0576, RV, TBD 2974, 186 m			

Material

62 valves.

Diagnosis

Reticulate species of *Kuiperiana* with small, posteriorly angular alae.

Description

External features. Small sized, sub-quadrate in lateral outline. AM asymmetrically rounded, PM with a blunt caudal process. DM straight, with small, prominent cardinal angles. There are narrow AM and PM rims. Surface overall reticulate, with short longitudinal ribs that converge anterior of the central area. There is a small, posteriorly angular ala that is ventrally directed. This enhances the convex VM outline. In dorsal view the carapace tapers anteriorly, and has a slight median constriction.

Internal features. Hinge gongyloidont, with a smooth ME and a strongly lobed PTE in RV. MS small, consisting of four rounded/elliptical adductors as two compound pairs, and a rounded eight-shaped frontal scar. Normal pore canals prominent and widely spaced.

Remarks

Reference of this species to *Kuiperiana* is not unequivocal because Bassiouni's type (*Loxoconcha wanneri* Kuiper, 1918) does not possess alae. However, the overall shape, ornamentation and hinge of *K. angulata* sp. nov. fit such a placement reasonably well. Whatley & Quanhong's (1987) genus *Alataconcha* is an alate loxoconchid, but it has a short hinge, a convex LV DM, and relatively large alae. In external view, *Kuiperiana angulata* is reminiscent of *Loxoconcha heronislandensis* Hartmann, 1981, which occurs widely in the south-eastern Pacific (see Whatley & Quanhong 1987), but lacks the latter species's prominent eye tubercle, and has more longitudinally aligned ornamentation. None of the loxoconchids previously reported from southern Africa can be confused with the alate *K. angulata*.

Distribution

This is the most widely distributed loxoconchid on the continental shelf of south-western Africa (Fig. 42A, B), although it rarely constitutes >10 per cent total ostracod assemblage.

The modern population of *Kuiperiana angulata* sp. nov. lies in a narrow belt between latitudes 19,9°S (Walvis Ridge abutment shelf) and 30°S (Hondeklip Bay, Namaqualand coast), where its UDL and LDL are 150 m and 283 m, respectively.

The main relict populations lie on the Walvis and Orange shelves, but there are three sites off the Cape Peninsula. Although the relict UDL is similar to that of the

modern fauna (131 m off the Cape Peninsula—Fig. 42B), the LDL suggests a large increase into deeper water compared to modern sites, and in the Walvis–Orange sector it may increase to 1 000 m (although the latter may be an allochthonous occurrence).

Plotting abundance against water depth for the total assemblage suggests two peaks: c. 300 m and 750 m. The shallower of these is probably real, but the veracity of the latter is uncertain.

Overall distribution of loxoconchids

Only two of the species that have been reported from the continental shelf off south-western Africa have a widespread distribution: *Palmoconcha walvisbaiensis*, which is confined to areas north of 27°S, and *Kuiperiana angulata*, which occurs along the whole margin from the Walvis Ridge abutment to south of the Cape Peninsula (Fig. 36). *Loxoconcha megapora* (including the variety *magna*) also has a wide geographical range, but so far reports of it have been confined to widely spaced coastal sites.

Two other shelf species have much more limited ranges: *Palmoconcha? walvisridgensis* is restricted to the subtropical northernmost area in the vicinity of the Walvis Ridge abutment, and *P. subrhomboidea* is restricted to the Agulhas Bank region, and penetrates along the west coast only as far as the Cape Peninsula.

Plotting the summed and smoothed abundances of the loxoconchids shows that north of approximately 25°S (middle of the Lüderitz–Walvis Bay shelf sector) they constitute the dominant modern ostracod taxon (Fig. 4). This is particularly so in the shelf sector between Walvis Bay and the Walvis Ridge abutment, where *P. walvisbaiensis* accounts for 98 per cent of the loxoconchid population. They are minor components of the modern fauna on the northern Orange Banks, and off the Cape Peninsula. Within the relict assemblages, the loxoconchids become increasingly abundant north of approximately 26°S, with peaks off Walvis Bay, on the Walvis Ridge abutment, and in the vicinity of the Kunene River (Fig. 5). They are an insignificant component of the relict fauna on the Orange Shelf, and areas farther south.

Changes in the relict and modern distributions of these taxa show that within the older populations two subtropical Atlantic species penetrated up to 200 km farther south: *P. walvisbaiensis*—2 degrees; and *P.? walvisridgensis*—2.5 degrees, whereas *Kuiperiana angulata* established a population off the Cape Peninsula, 400 km south of its modern limits, but did not inhabit the intervening area off the Namaqualand coast. In contrast, there was no corresponding extension north of the Cape Peninsula of the range of the warm water ('Agulhas') species *Palmoconcha subrhomboidea*.

Family **Trachyleberididae** Sylvester-Bradley, 1948

Genus *Ruggieria* Keij, 1957

Ruggieria cytheropteroides (Brady, 1880)

Figs 41D–F, 43A–B, 44

Cythere cytheropteroides Brady, 1880: 78, pl. 15 (figs 5a–d). Puri & Hulings, 1976: 272–273, pl. 9 (figs 5–8).

Bosquetina sp. Keeler, 1981: 41–43, pl. 2 (fig. 1).

Ruggieria cytheropteroides (Brady, 1880) Boomer, 1985: 19–21, pl. 1 (figs 1–3).

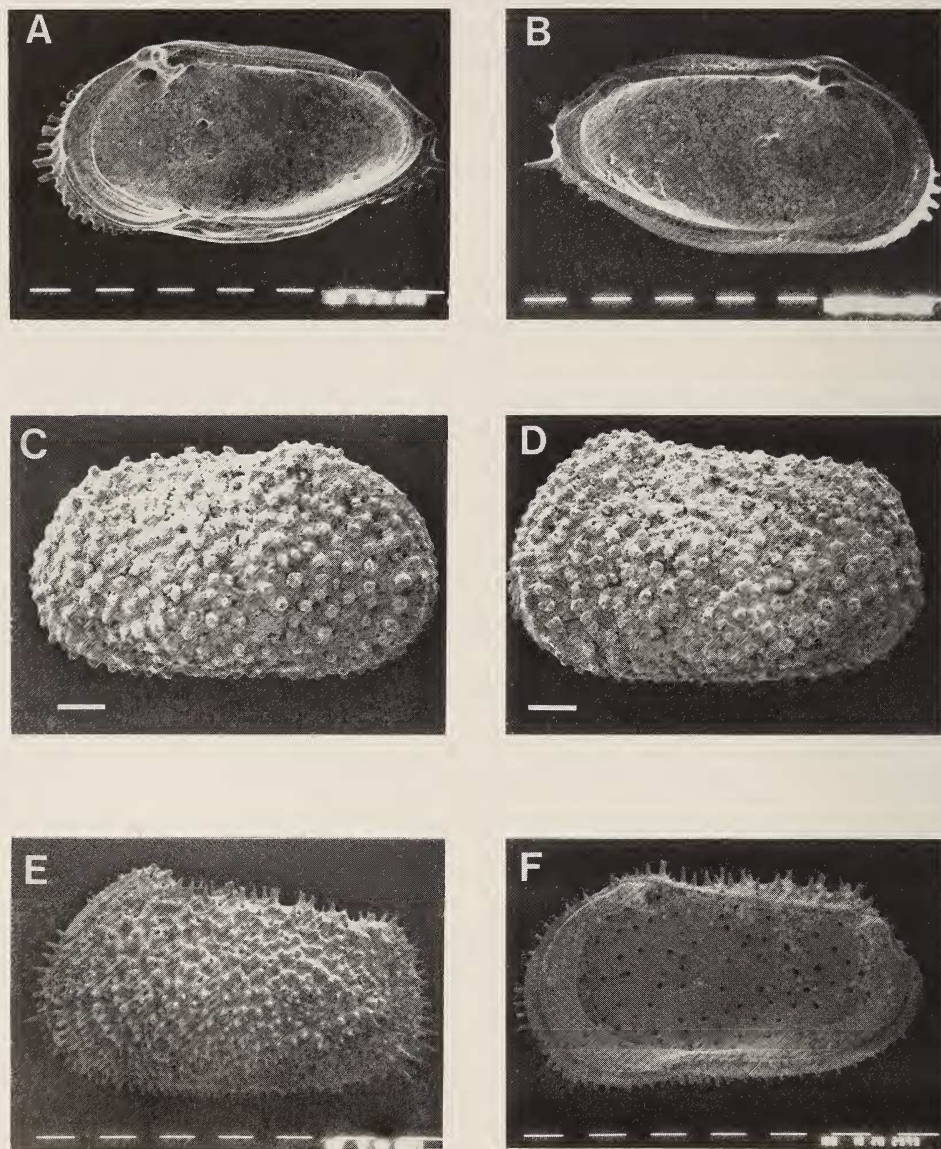


Fig. 43. A-B. *Ruggieria cytheropteroides* (Brady, 1880). A. SAM-PQ-MF0591, RV, TBD 3863, 150 m, SEM 2410. B. SAM-PQ-MF0592, LV, TBD 2975, 180 m, SEM 2405. C-F. *Henryhowella melobesioides* (Brady, 1869). C. SAM-PQ-MF0475, RV, TBD 311, 184 m, SEM 2625. D. SAM-PQ-MF0478, LV, TBD 311, 184 m, SEM 2626. E. SAM-PQ-MF0480, LV, TBD 3561, 655 m, SEM 2591. F. SAM-PQ-MF0481, RV, TBD 3561, 655 m, SEM 2493. Scale bars = 100 microns.

Illustrated material

- SAM-PQ-MF-0588, C, TBD 2472, 201 m
 SAM-PQ-MF-0589, LV, TBD 2975, 180 m
 SAM-PQ-MF-0590, RV, TBD 2975, 180 m
 SAM-PQ-MF-0591, RV, TBD 3863, 150 m
 SAM-PQ-MF-0592, LV, TBD 2975, 180 m

Material

5 489 valves.

Remarks

Ruggieria cytheropteroides differs from Keij's genotype (*Cythere micheliniana* Bosquet, 1852—see Uffenorde 1981, pl. 6 (figs 7, 10, 12)) from the Eocene–Oligocene of north-western Europe, in being slightly plumper, with a more prominent ventrolateral overhang. Otherwise the essential generic components are well seen in Brady's species (e.g. 1880, pl. 15 (fig. 5a)), although the lectotypes selected by Puri & Hulings (1976) are worn, broken and probably instars. Features of note are the prominent ventrolateral keel with a sharp posterior spine, the large ocular sinus, the denticulate hinge ME and the elongate and weakly lobate RV ME, and the MS with four large adductors, a relatively small U-shaped anterior scar, and a prominent pit and antero-adjacent boss in front of the dorsal adductor.

Ruggieria cytheropteroides is similar in outline and general appearance to two species that range along the northern Indian Ocean area (Gulf of Oman to Java Sea—Whatley & Quanhong 1988): *R. darwinii* (Brady, 1868) and *R. indopacifica* Whatley & Quanhong, 1988. Both these species differ from *R. cytheropteroides* in being coarsely reticulate.

Ruggieria and related genera are a widely distributed and diverse group on the continental shelf of western and south-western Africa. Three species of the genus have been recorded from the Tertiary of west and equatorial Africa: *R. tattami* Reyment, 1963 (Palaeocene–Eocene of Nigeria), and *R. tetraptera tetraptera* (Seguenza) and *R. rotundata* (Ruggieri) (Bold 1966—Mio–Pliocene of Gabon), but none of these species seems close to *R. cytheropteroides*, and may not be congeneric with Keij's types. Dingle (1976) did not report *Ruggieria* from the Tertiary of the Natal continental shelf, but Frewin (1987) illustrated an elongate species with strong posteroventral spines (*Ruggieria* sp. A485) from the Upper Eocene of the eastern Agulhas Bank.



Fig. 44. Muscle scars of *Ruggieria cytheropteroides* (Brady, 1880), SAM-PQ-MF0591, RV, TBD 3863, 150 m, SEM 2411. Scale bar = 100 microns.

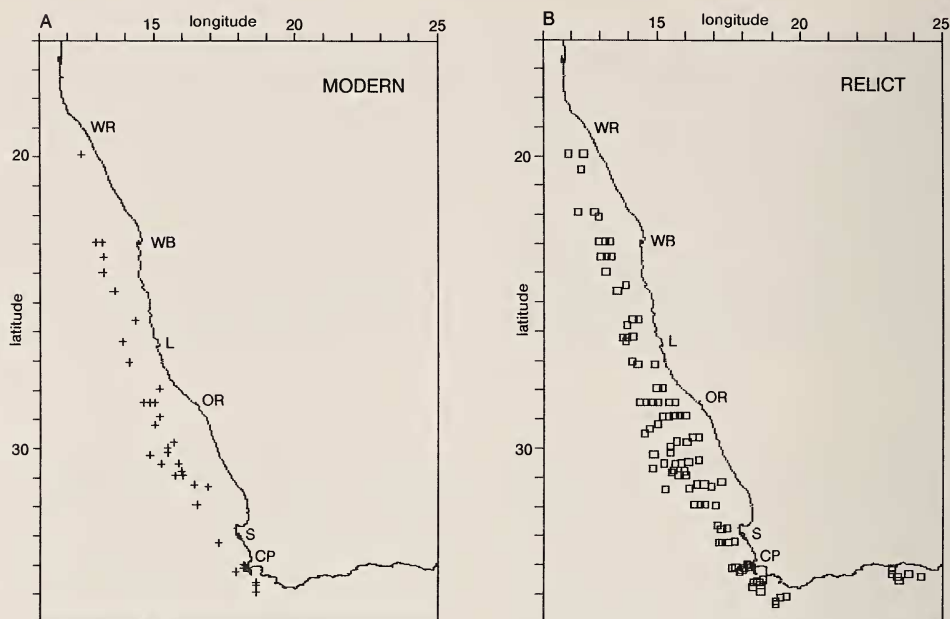


Fig. 45. Distribution of *Ruggieria cytheropteroides* (Brady, 1880). A. Modern sites. B. Relict sites. See Fig. 7 for abbreviations.

Keen (1975) recorded eight Recent species of the genus from the continental shelf off West Africa (although he suspected that they are in fact not congeneric with the holotype): *R. triangulata* Omatsola, 1972 (20–80 m), *R. beninensis* Omatsola, 1972 (20–30 m), *R. lekki* Omatsola, 1972 (20–30 m), *R. nigeriana* Omatsola, 1970 (20–30 m), *R. martinssoni* Omatsola, 1972 (0–110 m, 10–60 m living), *R. tricostata* Omatsola, 1972 (20–30 m), *R. boldi* Keen, 1975 (20 m), and *R. leonensis* Keen, 1975 (sandy sediments, 60–110 m). The last-named is very similar in shape, ornamentation and internal features to *R. cytheropteroides*. It differs in having a faint surface reticulation, a weak AM ridge, and in being slightly more triangular in lateral outline over the anterior cardinal angle. Clearly, the two species are closely related.

Babinot & Kouyoumontzakis (1986) have recorded three of the West Africa taxa from modern sediments off the mouth of the Congo River: *R. lekki* (38–44 m); *R. martinssoni* (38 m); and *Ruggieria* aff. *R. triangulata* (38 m).

Distribution

Brady (1880) recorded this species from 'Challenger' Station 142 off the Cape of Good Hope (300 m).

Ruggieria cytheropteroides (combined modern and relict specimens) is overall the second most abundant ostracod taxon (after *Pseudokeijella lepralioides* (Brady, 1880)) on the south-western African continental shelf (22% of all specimens recorded in the present study, 39% of specimens in the samples containing the dominant taxa).

Modern specimens extend over a latitudinal range of 15 degrees between 19° and 35°S (Figs 4, 45A, 46). Off the Cape Peninsula (Fig. 46C) the species occurs in water

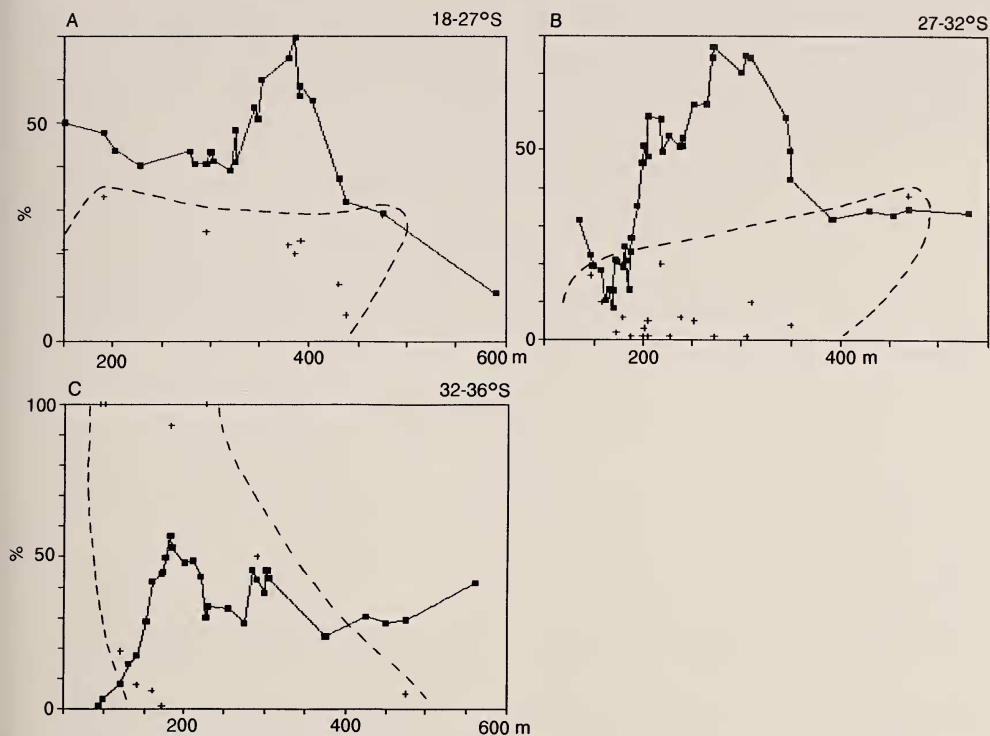


Fig. 46. Abundance of *Ruggieria cytheropteroides* (Brady, 1880) as percentage of ostracod fauna plotted against water depth (5-point running means). Modern populations (crosses) enclosed by dashed line. A. 18–27°S. B. 27–32°S. C. 32–36°S.

depths between 94 m and either 290 m or 475 m (the latter may be allochthonous), whereas north of 32°S (Fig. 46B) it occupies mid-outer shelf depths between 147 m and 469 m. The species becomes less abundant north of 27°S, and occurs in water depths between 150 m and 475 m (Fig. 46A). In the vicinity of Walvis Bay (23–25°S) the UDL of *R. cytheropteroides* increases to 295 m and the species is confined to the outer shelf area. The northernmost sample site on the Walvis Ridge shelf is a single valve.

These distributions give overall UDL and LDL of modern specimens for the west coast as 94–475 m, with water depths of the main population abundances for the Walvis, Lüderitz–Orange–Namaqualand, and south-western Cape areas decreasing steadily southward from 400 m, via 200 m to 150 m.

Relict specimens of *R. cytheropteroides* occur over the same latitude range as the modern populations (i.e. Walvis Ridge abutment 19°S to south-western Cape 35°S: Fig. 45B). The overall pattern of their latitudinal abundances is also similar (Figs 4, 5), with the main concentration of high abundance samples on the Namaqualand–Orange Shelf sector. Across-shelf profiles (Fig. 46A, B) show that in the northern sector, the maximum population abundance lies on the outer shelf (c. 370 m), and that it moves inshore to c. 300 m on the Orange Shelf. The abundance/water depth

profile is more complicated off the south-western Cape (Fig. 46C) where the major abundance peak occurs at c. 190 m, with only a minor peak at the c. 300 m.

Table 4 and Figure 47 summarize the depth range changes for the various *R. cytheropteroides* populations.

Subfamily Trachyleberidinae Sylvester-Bradley, 1948

Genus *Henryhowella* Puri, 1957

Aspects of the status of this genus have recently been reviewed by Dingle *et al.* (1990), particularly as they pertain to local species. The present publication adopts their taxonomic strategy.

Henryhowella melobesioides (Brady, 1869)

Fig. 43C–F

Cythere melobesioides Brady, 1869: 162, pl. 12 (figs 10–11); 1880: 108, pl. 18 (figs 1c–g). Puri & Hulings, 1976, pl. 25 (figs 1–2).

non *Cythere melobesioides* Brady, 1869. Brady, 1880, pl. 18 (figs 1a–d).

Cythere nodulifera Brady, 1869: 163, pl. 19 (figs 24–25).

Henryhowella sp. Keeler, 1981: 162–163, pl. 9 (fig. 14).

Henryhowella sp. Boomer, 1985, pl. 1 (figs 6–8, 18).

non *Henryhowella* sp. Boomer, 1985: 25–27, pl. 3 (figs 38–39).

Henryhowella melobesioides (Brady, 1869) Dingle *et al.*, 1990: 311–318, figs 42C–F, 43A–F, 44A–D, 47A.

Illustrated material

SAM-PQ-MF-0475, RV, TBD 311, 184 m

SAM-PQ-MF-0478, LV, TBD 311, 184 m

SAM-PQ-MF-0480, LV, TBD 3561, 655 m

SAM-PQ-MF-0481, RV, TBD 3561, 655 m

TABLE 4

Water depth distribution of *Ruggieria cytheropteroides*.

	UDL (m)	LDL (m)	Depth range (m)	Main conc. (m)	Shift (m)
MODERN					
North	150	475	325	400	
Orange–Namaqualand	147	469	322	200	
South-western Cape	94	475 or 290	381 or 200	150	
RELICT					
North	150	590	440	370	-30
Orange–Namaqualand	135	530	395	290	+90
South-western Cape	94	560	466	190 and 300	+40 and +150

UDL – upper depth limit

LDL – lower depth limit

Main conc. – depth of the sites with greatest abundances

Shift – difference between relict and modern depths of greatest abundances

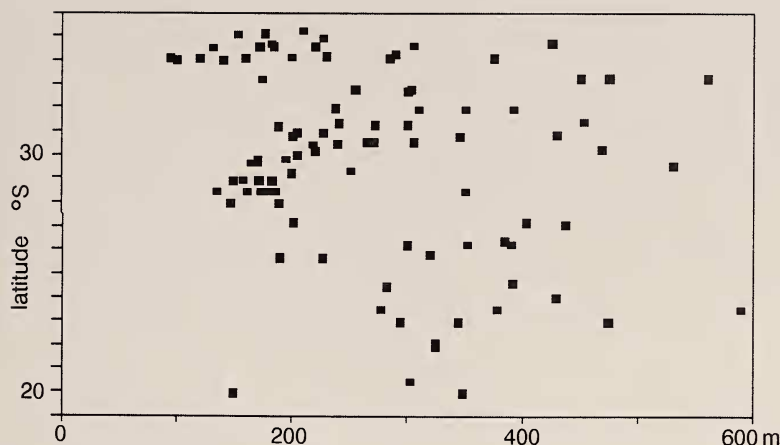


Fig. 47. Latitudinal water-depth distribution of sites with *Ruggieria cytheropteroides* (Brady, 1880).

Material

429 valves.

Remarks

Dingle *et al.* (1990) could not recognize any geographical consistency in the morphological variation of individuals in the populations of *Henryhowella* on the continental margin off south-western Africa. Consequently, in view of the uncertainty surrounding the taxonomy of widely reported species such as *H. asperrima* (Reuss, 1850), they considered all morphological variants on the continental margin off south-western Africa could be accommodated in Brady's species *H. melobesioides* (Brady, 1869), which he regarded (Brady 1880) as conspecific with the type specimens from Mauritius (Brady 1869). I adhere to this view.

Brady (1880) recorded *H. melobesioides* from *c.* 300 m (150 fm) off the Cape Peninsula, and his figured specimens have relatively nodose spines. Dingle *et al.* (1990) remarked that the deeper-water populations tend to have more slender spines, and that coarsely spinose individuals are representative of the continental shelf populations (compare Figs 43C, D with Fig. 43E). I regard this as a response to environmental factors (e.g. energy of bottom water).

Distribution

Henryhowella melobesioides is widely distributed along the continental margin of south-western Africa (Fig. 48A, B) but, because Keeler (1981) did not find it on the eastern Agulhas Bank, the eastward limit of the species lies between 19,28°E and 23,21°E. It is essentially a cold-water, west-coast taxon around southern Africa.

Modern populations occur along the west-coast margin between 35° and 19°S. Off the Cape Peninsula the depth range is 140–290 m, but it increases to 430–990 m at the latitude of Saldanha Bay. Consequently, north of the Cape Canyon (33,5°S) there are no modern populations of *H. melobesioides* on the continental shelf. A wide barren

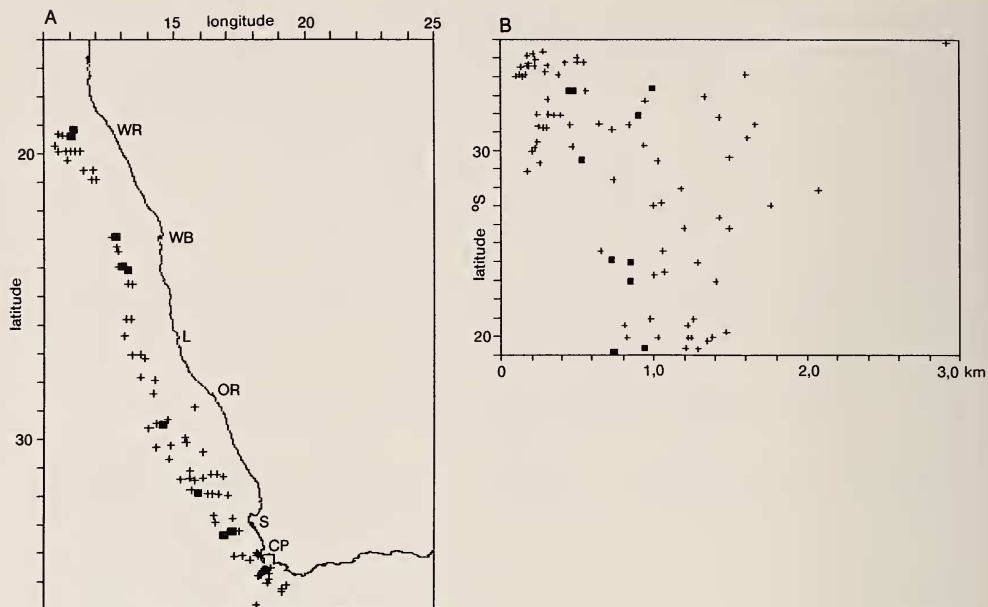


Fig. 48. A. Distribution of *Henryhowella melobesioides* (Brady, 1869). Crosses = relict sites, solid squares = modern sites. See Fig. 7 for abbreviations. B. Latitudinal water-depth distribution of sites with *H. melobesioides* (Brady, 1869). Crosses = relict sites, solid squares = modern sites.

zone between the Orange River and Lüderitz separates the Namaqualand and Lüderitz-Walvis Bay upper slope populations (Fig. 4), where in the latter the UDL and LDL are 725 m and 1 430 m. Clearly, the whole of the low dissolved oxygen environment of the Walvis shelf, and the suspensate rich and lower-salinity shelf adjacent to the Orange River are environmentally unsuitable for modern populations.

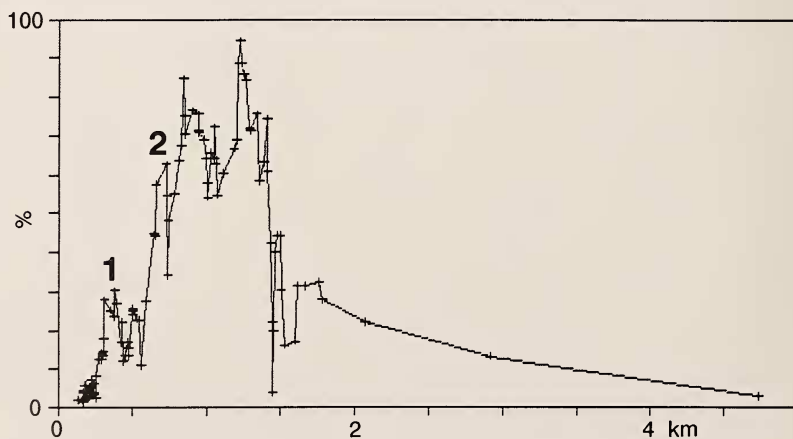


Fig. 49. Abundance of *Henryhowella melobesioides* (Brady, 1869) as percentage of ostracod fauna plotted against water depth (5 point running means). 1 = abundance peak on outer shelf off south-western Cape. 2 = abundance peak off Namaqualand.

Relict distribution patterns are similar to those of the modern populations, with the exception of the area off Namaqualand, where the UDL is similar to that off the Cape Peninsula (c. 100 m). A notable similarity between the two populations is the absence of both modern and relict faunas in the Walvis–Orange shelf area. A major difference is in the overall greater LDL of relict populations, with specimens occurring to a maximum of 2 916 m in the extreme south.

Dingle *et al.* (1990) have previously considered the distribution of *H. melobesioides* in deep water (>950 m), and Figure 53 shows a summed population profile across the margin into abyssal depths. The species dominates the ostracod populations between about 750 m and 1 500 m (from the core of the salinity minimum zone to the base of the Antarctic Intermediate Water mass). Dingle *et al.* (1989) have suggested that this is an Atlantic-wide phenomenon. The minor peak at the shallow (left side) of Figure 49 reflects an abundance of *H. melobesioides* on the upper slope west of the Cape Peninsula.

Genus *Pseudokeijella* gen. nov.

Diagnosis

Plump, ovate genus. Ornamentation is densely reticulate, with two antero-marginal ribs emanating from a moderate to prominent eye spot. PM is spinose posteroventrally. There is no ventrolateral carina or tendency to develop ventrolateral spines or ridges. Hinge is holamphidont with denticulate LV ME. MS have an anterior structure consisting of two very small, close-lying or partially fused scars (in a compressed U-shaped), and four adductors of which the second is long and curved and the others small and rounded.

Type species. *Cythere lepralioides* Brady, 1880.

Derivation of name

Pseudo- plus *Keijella* with reference to similarity to this genus.

Remarks

This genus is erected to accommodate a species that is closely allied to the two genera *Ruggieria* Keij, 1957, and *Keijella* Ruggieri, 1967, but which differs from both on significant features of outline, ornamentation and MS.

The type species of *Ruggieria* is *Cythere micheliniana* Bosquet, 1852, which is carinate with a posteroventral spine, and bears several further longitudinal ridges. Keij (1957) specifically mentioned in his remarks that *Ruggieria* lacks ornamentation with concentricity. This genus is represented off south-western Africa by a typical species, *Ruggieria cytheropteroides* (Brady, 1880).

Keijella is based on the species *Cythere hodgii* Brady, 1866. The type specimen of this species, from the eastern Mediterranean, is lost, but Doruk (1973) has illustrated topotypic material, as well as erecting two new species of the genus from Turkey. This is an elongate taxon with a postero-ventrolateral spine and/or swelling whose valve surface is either smooth, or has longitudinal rows of elongate fossae ('slots' of Doruk 1973).

Pseudokeijella has some features of both these genera, and on balance is closer to *Keijella* (hence the name) (Fig. 51). It differs from *Ruggieria* by lacking the characteristic ventrolateral carina, but the MS are similar, with the third scar small and round and set distinctly posterior to the fourth, and the second elongate. *Keijella* lacks a ventrolateral carina, and prominent longitudinal ridges, with the result that the overall shape and surface ornamentation are more similar to those of *Pseudokeijella*. However, *Pseudokeijella* has an ovate outline (in contrast to the elongate subquadrate outline of *Keijella*), is plumper, and lacks any postero-ventrolateral spine or swelling. The MS of *Keijella* and *Pseudokeijella* differ to the extent that the adductors of the former are more elongate, and the anterior scar of the type species has the shape of three sides of a rectangle.

Whatley & Quanhong (1988) have reported 10 species of *Keijella* from the Malacca Straits region. I suspect that at least two of these (*K. japonica* (Ishizaki) and *K. reticulata* Whatley & Quanhong) belong to *Pseudokeijella*. In addition, several species previously referred to *Leguminocythereis* appear close to *Pseudokeijella* in outline and ornamentation (their internal features are mostly not known). Within this category I include *Leguminocythereis lokossaensis* Apostolescu, 1961, *Leguminocythereis frescoensis* Apostolescu, 1961, ?*Leguminocythereis* cf. *L. lokossaensis* Apostolescu (Dingle 1976), ?*Leguminocythereis* sp. 1 Dingle, 1976; *Leguminocythereis* cf. *L. exigua* (Apostolescu) (Frewin 1987); *Leguminocythereis* sp. 1507 Frewin, 1987.

Pseudokeijella lepralioides (Brady, 1880)

Figs 50A–F, 51E–F, 55E–F

Cythere lepralioides Brady, 1880: 94, pl. 19 (figs 5a–d). Puri & Hulings, 1976: 280–281, pl. 12 (figs 10–11).

Ruggieria lepralioides (Brady) Keeler, 1981: 173–175, pl. 10 (figs 1–3).

Leguminocythereis? sp. Boomer, 1985: 47–49, pl. 1 (figs 4–5).

Leguminocythereis sp. 1507 Frewin, 1987: 44–45, pl. 15A–D.

Illustrated material

SAM-PQ-MF-0557, LV, TBD 6824, 90 m

SAM-PQ-MF-0558, RV, TBD 6824, 90 m

SAM-PQ-MF-0559, RV, TBD 6836, 80 m

SAM-PQ-MF-0560, LV, TBD 6836, 80 m

SAM-PQ-MF-0561, carapace, TBD 6847, 94 m

Material

8 181 valves.

Remarks

The lectotype of Brady's (1880) species selected by Puri & Hulings (1976) is probably a penultimate instar, which has signs of physical wear. Our material shows that the ventral parts of the AM and PM are spinose, and that the eye spot is moderately well-developed, with two ribs running from it sub-parallel to the AM. The hinge is holamphidont with, in the RV, a prominent tooth at the posterior part of the ATE, an ovate smooth PTE, and a straight, denticulate ME. There is a deep internal ocular

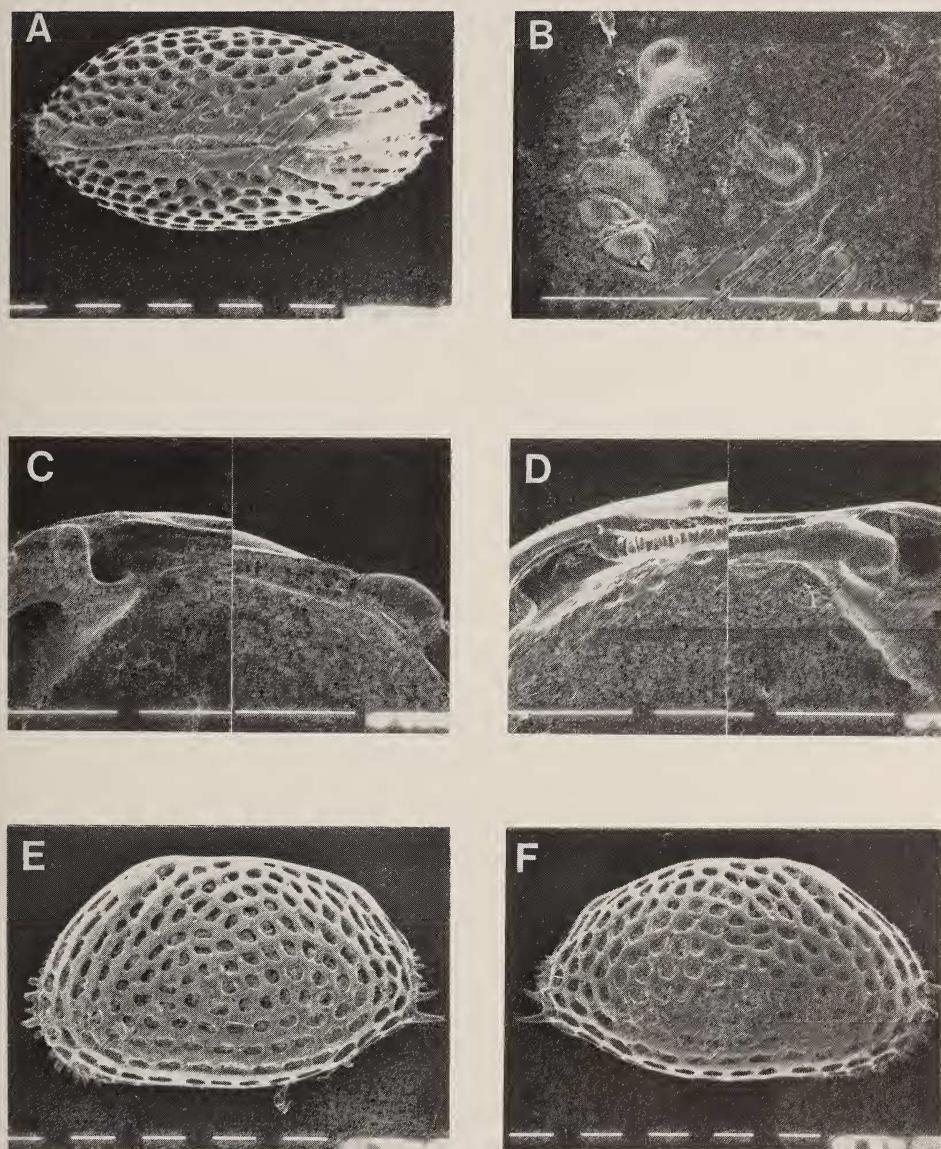


Fig. 50. A-F. *Pseudokeijella lepralioides* (Brady, 1880). A. SAM-PQ-MF0561, carapace, dorsal view, TBD 6847, 94 m, SEM 2389. B. SAM-PQ-MF0560, LV, MS, TBD 6836, 80 m, SEM 2381. C. SAM-PQ-MF0559, RV, hinge, TBD 6836, 80 m, SEM 2387-88. D. SAM-PQ-MF0560, LV, hinge, TBD 6836, 80 m, SEM 2382-83. E-F. TBD 6824, 90 m. E. SAM-PQ-MF0557, LV, SEM 2372. F. SAM-PQ-MF0558, RV, SEM 2377. Scale bars = 100 microns.

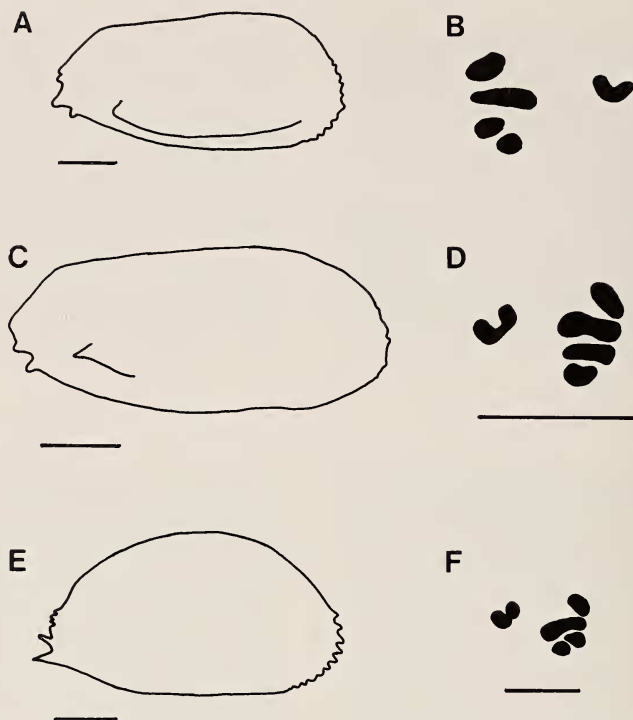


Fig. 51. Comparison of outline and MS of *Pseudokeijella* gen. nov. with *Ruggieria* Keij, 1957, and *Keijella* Ruggieri, 1967. A–B. *Ruggieria micheliniana* (Bosquet, 1852), type species of *Ruggieria* Keij, 1957. A. Specimen from Lower Miocene of Northern Germany (after Uffenorde 1981, pl. 6 (fig. 7)). B. Specimen from Lower Miocene of France (after Keij 1957, pl. 15 (fig. 5)). C–D. *Keijella hodgii* (Brady, 1866), type species of *Keijella* Ruggieri, 1967. C. Specimen from Upper Miocene of Turkey (after Doruk 1973, pl. 1:9:54 (1)). D. Specimen from Mio–Pliocene of San Marino (after Doruk 1973, pl. 1:9:56 (3)). E–F. *Pseudokeijella lepralioides* (Brady, 1880). E. SAM-PQ-MF0558, RV, TBD 6824, 90 m. F. SAM-PQ-MF0559, RV, TBD 6836, 80 m. Scale bars. A, C, E = 200 microns; D, F = 100 microns; B unknown.

sinus anterior to the anterior hinge elements. The MS pattern consists of four dissimilarly sized adductors, two small anterior spots that lie very close, or are partly fused to a flattened U-shape, and a prominent fulcral point. There is no noticeable MS depression, and consequently no STC on the outer lateral surface. In dorsal view, *P. lepralioides* is elliptical.

Distribution

Brady (1880) reported this species from two localities off south-western Africa: Station 140 in False Bay (30–40 m), and Station 142, south-west of the Cape of Good Hope (300 m).

Pseudokeijella lepralioides (combined modern and relict specimens) is overall the most abundant ostracod taxon on the south-western African continental shelf (32% of all specimens recorded in the present study, 39% of specimens in the samples con-

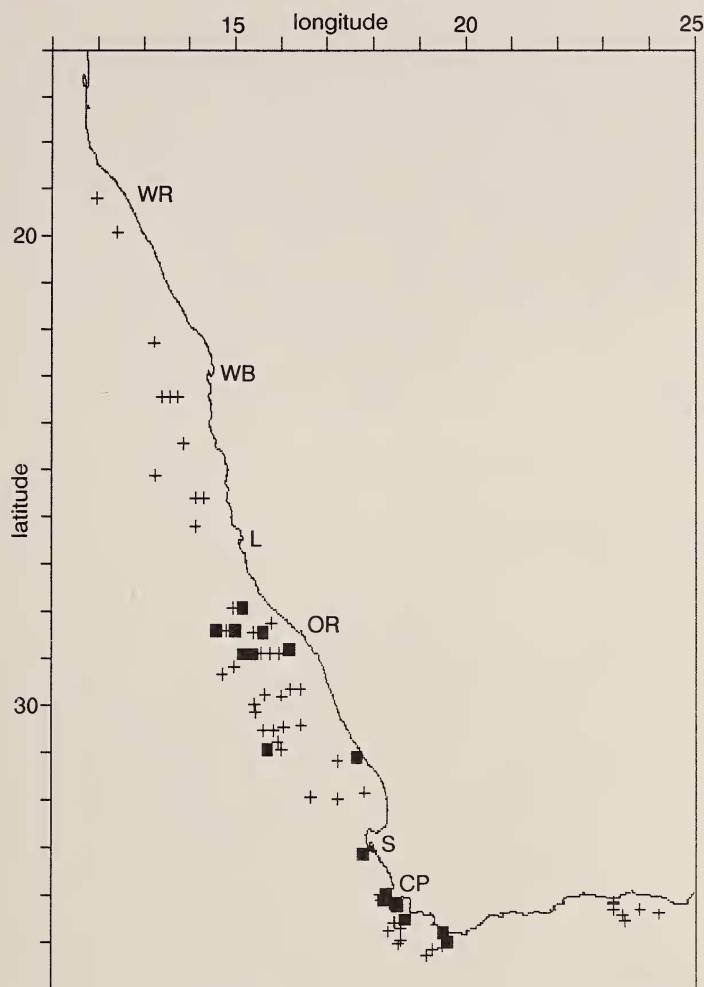


Fig. 52. Distribution of *Pseudokeijella lepralioides* (Brady, 1880). Crosses = relict sites, solid squares = modern sites. See Fig. 7 for abbreviations.

taining the dominant taxa of this paper), and Keeler (1981) recorded it as the most abundant species on the eastern Agulhas Bank (average 10% in 8 samples).

Modern specimens are concentrated in two areas (Figs 4, 52). On the Orange Shelf directly west of the Orange River (28–29°S), where UDL and LDL lie between 126 m and 183 m water depth, and between Cape Columbine (33°S) and Cape Agulhas where the species occurs between 40 m and 155 m. Two isolated occurrences off the Namaqualand coast in 88 m and 205 m.

The modern populations are most abundant on the Orange Shelf at c. 160 m, and off the south-western Cape at c. 100 m.

Relict specimens of *P. lepralioides* occur on the Walvis Ridge shelf (19°S) and the eastern Agulhas Bank (Figs 5, 52). The greatest abundance of relict specimens lies on

TABLE 5
Water depth distribution of *Pseudokeijella lepralioides*.

	UDL (m)	LDL (m)	Depth range (m)	Shift (m)
MODERN				
Orange	126	183	57	
Namaqualand	88	205	117	
South-western Cape	40	155	115	
RELICT				
Walvis	150	300	150	—
Orange	100	240	140	83
Namaqualand	88	310	222	105
South-western Cape	40	220	180	65

UDL — upper depth limit

LDL — lower depth limit

Shift — difference between relict and modern depth ranges

the Orange Shelf and, in contrast to the modern populations, the species is relatively poorly represented off the south-western Cape, although here relict specimens of *P. lepralioides* are an important secondary element. There is a southward decrease in the UDL from 150 m on the Walvis Shelf to 88 m off Namaqualand, and 40 m off the Cape Peninsula, and a corresponding, but less marked, decrease in LDL from c. 300 m on the Orange Shelf and areas farther north, to 220 m in the south.

Across-shelf abundances decrease in the northern area (18–32°S), with major changes at 160 m and 200 m, but in the south (32–36°S), there is a general increase to about 200 m, beyond which values decline.

Table 5 and Figure 53 summarize the depth range changes for the various *P. lepralioides* populations.

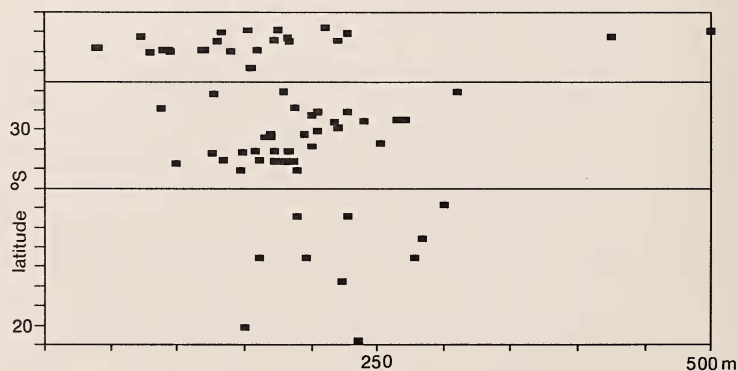


Fig. 53. Latitudinal water-depth distribution of sites with *Pseudokeijella lepralioides* (Brady, 1880).

Family **Xestoleberididae** Sars, 1928Genus *Xestoleberis* Sars, 1866

Fourteen species of this genus have been recorded around southern and south-western Africa. Nine of these occur in the present study area: *Xestoleberis africana* Brady, 1880—west coast continental shelf to Agulhas Bank; *Xestoleberis hartmanni* sp. nov.—continental shelf west of the Cape Peninsula to Cape Agulhas; *Xestoleberis ramosa* Müller, 1908—coastal sites from Lüderitz to Simonstown harbour (False Bay); *Xestoleberis capensis* Müller, 1908—coastal sites from Simonstown harbour to Knysna Lagoon; *Xestoleberis crenulata* Klie, 1940—Lüderitz Bay; *Xestoleberis ferax* Klie, 1940—Lüderitz Bay; *Xestoleberis baja* Klie, 1940—Lüderitz Bay; *Xestoleberis humilis* Klie, 1940—Lüderitz Bay; and *Xestoleberis* aff. *X. rotunda* Hartmann, 1964 (Hartmann 1974)—coastal sites Cacuo (Mozambique) to Lüderitz.

Xestoleberis africana Brady, 1880

Figs 54A–E, 56A–B

Xestoleberis africana Brady, 1880: 126, pl. 30 (figs 4a–c). Puri & Hulings 1976, 299, pl. 19 (figs 15–16).

?*Xestoleberis* sp. B Keeler, 1981: 182–183, pl. 10 (figs 14–15).

Xestoleberis spp. Boomer, 1985: 60–61, pl. 3 (figs 52–53).

Illustrated material

SAM-PQ-MF-0583, RV, TBD 6847, 94 m

SAM-PQ-MF-0584, LV, TBD 6847, 94 m

SAM-PQ-MF-0585, LV, TBD 6847, 94 m

SAM-PQ-MF-0586, RV, TBD 6847, 94 m

SAM-PQ-MF-0587, C, TBD, 6847, 94 m

Material

500 valves.

Remarks

This distinctively shaped, rather globular, thick-shelled species was re-illustrated by Puri & Hulings (1976). My SEM photographs show that the ME of the hinge in the RV and LV is locellate and denticulate, respectively, and not smooth as reported in the description of the lectotype. The small '*Xestoleberis*' spot is well illustrated in Figure 54D.

Distribution

Brady (1880) originally recorded this species only from 'Challenger' Station 140 in False Bay (15–20 fm (27–37 m)). The present study shows it to be the most widely distributed species of the genus on the continental shelf off south-western Africa (Fig. 57A).

Modern populations of *X. africana* are restricted to a narrow depth range off the Cape Peninsula (33,96–34,09°S; 80–95 m) and in False Bay (40 m) (Fig. 57B).

Relict specimens occur over a latitudinal range 22°S (Walvis Bay) to the eastern Agulhas Bank, and fall into three population groups. Two sites occur in the north

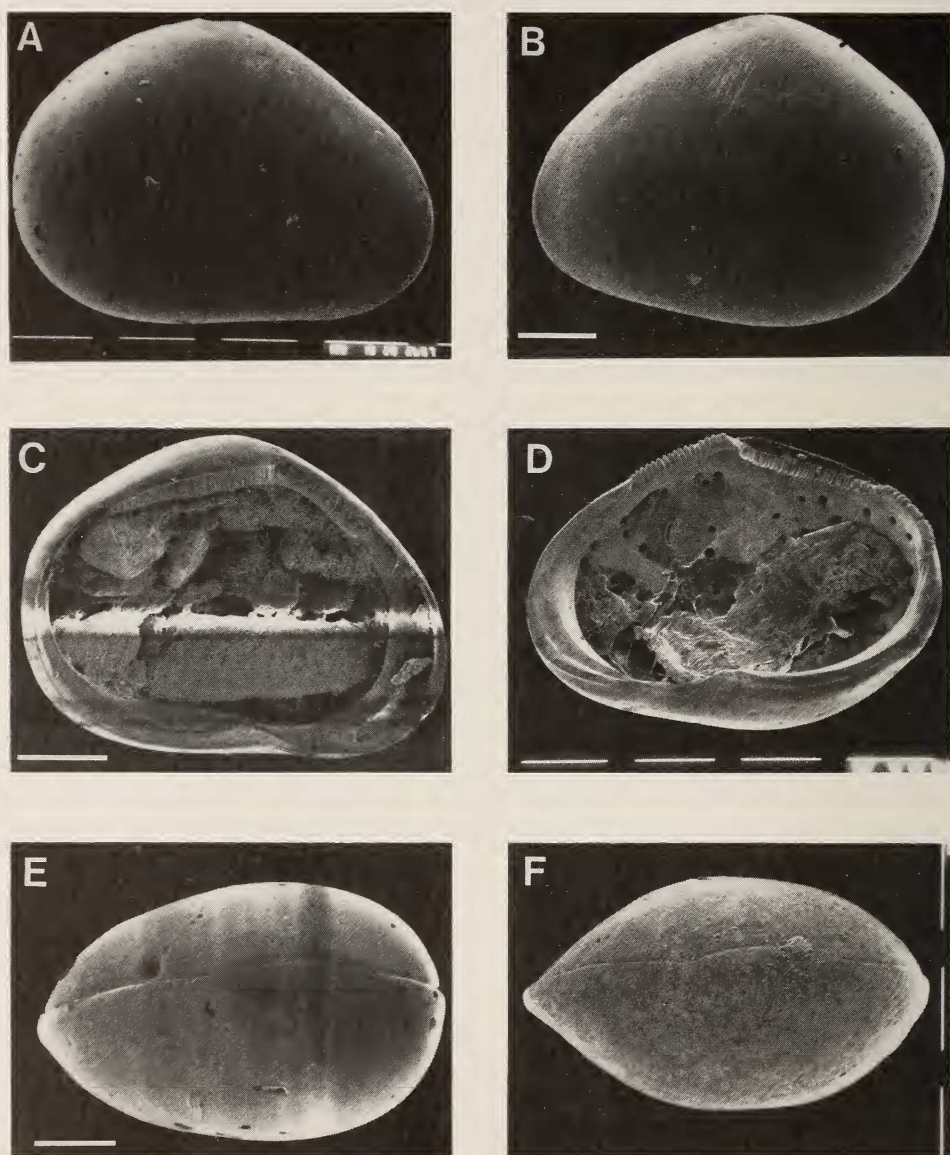


Fig. 54. A-E. *Xestoleberis africana* Brady, 1880, TBD 6847, 94 m. A. SAM-PQ-MF0583, RV, SEM 2657. B. SAM-PQ-MF0584, LV, SEM 2658. C. SAM-PQ-MF0585, LV, SEM 2663. D. SAM-PQ-MF0586, RV, SEM 2652. E. SAM-PQ-MF0587, carapace, dorsal view, SEM 2661. F. *Xestoleberis hartmanni* sp. nov. SAM-PQ-MF0579, carapace, dorsal view, TBD 6825, 160 m, SEM 2677. Scale bars = 100 microns.

(vicinity of Walvis Bay), a cluster of sites lies on the Orange–Namaqualand shelf between the Orange and Olifants rivers, and a third centre extends from the Cape Peninsula to the eastern Agulhas Bank. The upper depth limits of the sites north of 34°S all lie deeper than 173 m, whereas in the south relict specimens occur as shallow as 40 m in False Bay. With the exception of one isolated deep site, the lower depth limits along the whole shelf lie between 283 m and 290 m (Fig. 57C). The deep site (in 545 m) is relatively isolated from the main south-western Cape populations and contains a single, probably allochthonous valve.

Xestoleberis hartmanni sp. nov.

Figs 54F, 55A–D, 56G–H, S, 58

Derivation of name

The species is named for Professor G. Hartmann (University of Hamburg) for his important contribution to the study of modern marine ostracods around southern Africa.

Holotype

	length	height
SAM–PQ–MF–0578, LV, TBD 6825, 160 m	0,51 mm	0,38 mm

Paratypes

	length	height	width
SAM–PQ–MF–0579, C, TBD 6825, 160 m	0,51 mm	—	0,30 mm
SAM–PQ–MF–0580, RV, TBD 6825, 160 m	0,49 mm	0,30 mm	—
SAM–PQ–MF–0581, LV, TBD 6825, 160 m	0,51 mm	0,34 mm	—
SAM–PQ–MF–0582, RV, TBD 6825, 160 m	0,45 mm	0,29 mm	—

Material

20 valves.

Diagnosis

Species with an ‘angular’ aspect resulting from a strongly and asymmetrically arched DM, with the addition of a truncated posterodorsal margin in the RV. RV and LV hinge ME are locellate and denticulate, respectively.

Description

External features. LV and RV differ considerably in lateral outline. In both valves the narrow AM is asymmetrically rounded, ventrally directed and somewhat extended. In LV the PM is broadly rounded, with a continuous sweep over the posterodorsal area. In RV the PM is truncated, rounded ventrally, but angular across the posterodorsal area. The LV DM is strongly arched, with the rounded, highest point just behind mid-length. This contrasts with the RV DM, which is straight to the rounded highest point (lying just anterior of mid-length), whence the DM sweeps downward to the AM. In both valves the VM is slightly convex. In dorsal view the carapace is lemon-shaped: distinctly acuminate anteriorly, and more rounded, but

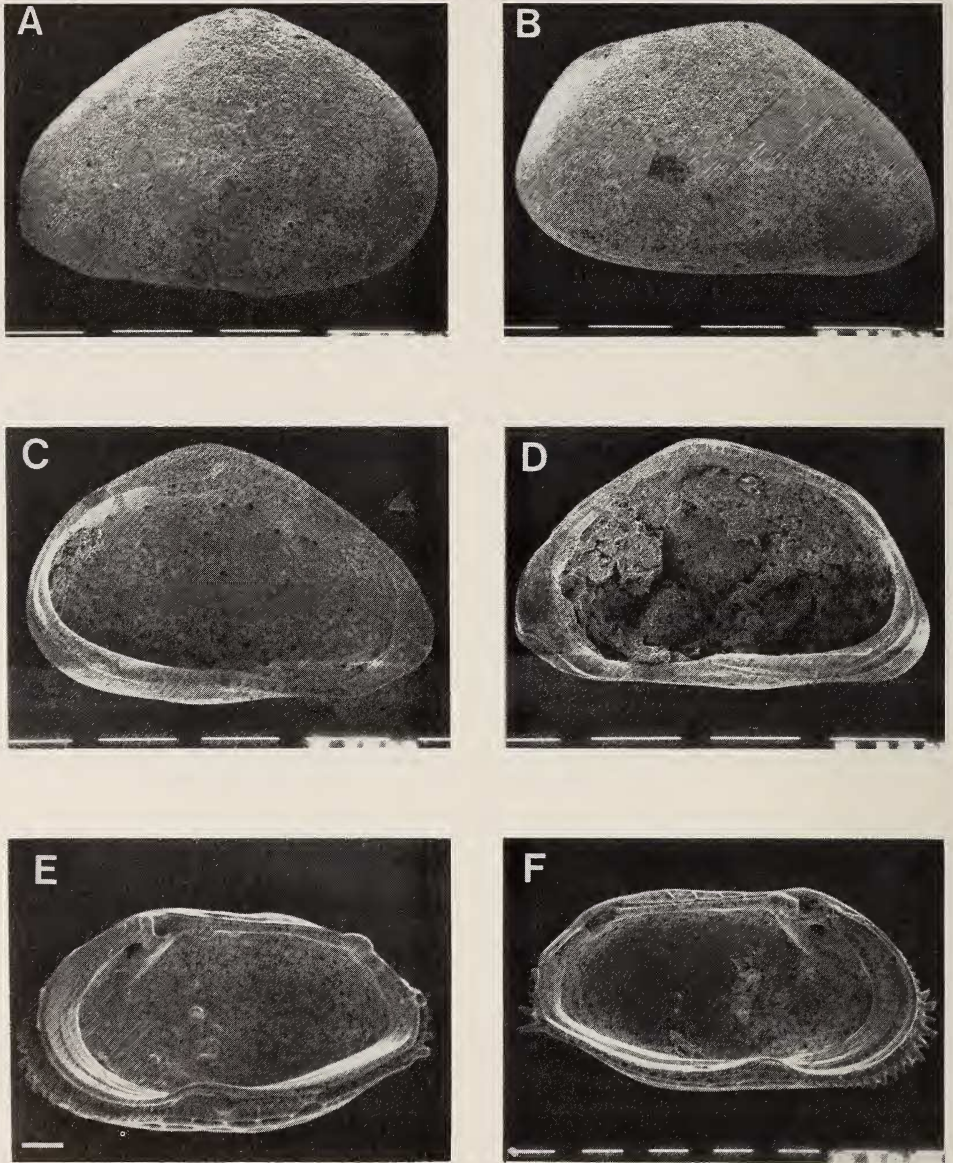


Fig. 55. A–D. *Xestoleberis hartmanni* sp. nov., TBD 6825, 160 m. A. SAM-PQ-MF0578, holotype, LV, SEM 2673. B. SAM-PQ-MF0580, RV, SEM 2674. C. SAM-PQ-MF0581, LV, SEM 2678. D. SAM-PQ-MF0582, RV, SEM 2681. E–F. *Pseudokeijella lepralioides* (Brady, 1880), TBD 6836, 80 m. E. SAM-PQ-MF0559, RV, SEM 2385. F. SAM-PQ-MF0560, LV, SEM 2380. Scale bars = 100 microns.

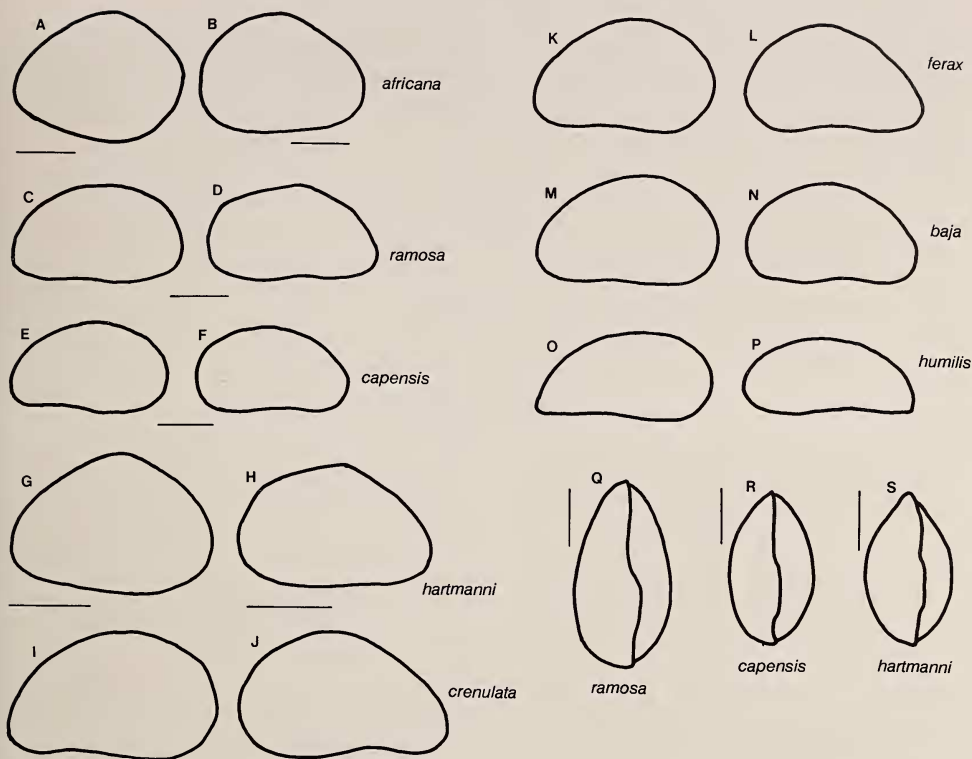


Fig. 56. Outlines of *Xestoleberis* species from southern Africa. A–B. *X. africana* (Brady, 1880), TBD 6847, 94 m. A. SAM–PQ–MF0574, LV. B. SAM–PQ–MF0573, RV. C–D, Q. *X. ramosa* Müller, Simonstown harbour, traced from Müller (1908: 129). C. LV. D. RV. Q. Carapace, dorsal view. E–F, R. *X. capensis* Müller, Simonstown harbour, traced from Müller (1908: 127). E. LV. F. RV. R. Carapace, dorsal view. G–H, S. *X. hartmanni* sp. nov., TBD 6825, 160 m. G. SAM–PQ–MF0578, holotype, LV. H. SAM–PQ–MF0580, RV. S. SAM–PQ–MF0579, carapace, dorsal view. I–J. *X. crenulata* Klie, Lüderitz Bay, traced from Klie (1940, figs 44–45). I. LV. J. RV. K–L. *X. ferax* Klie, Lüderitz Bay, traced from Klie (1940, figs 51–52). K. LV. L. RV. M–N. *X. baja* Klie, Lüderitz Bay, traced from Klie (1940, figs 57–58). M. LV. N. RV. O–P. *X. humilis* Klie, Lüderitz Bay, traced from Klie (1940, figs 61–62). O. LV. P. RV. Scale bars = 200 microns; other scales not known.

somewhat drawn out posteriorly. Valve surface is smooth, with numerous, distinct, but small normal pore openings.

Internal features. Marginal areas are relatively narrow, but in the material available details were not well preserved. The hinge is antimerodont, with relatively short terminal elements, with a locellate ME in the RV. No unambiguous views of the MS were obtained because of generally poor preservation, but the adductors consist of four elongate scars, with a small U- or V-shaped anterior scar and a further small ventrally adjacent scar (Fig. 58). The '*Xestoleberis*' spot is indistinct, dorsally situated and small. There is no well-developed eye socket.

Remarks

None of the other locally occurring species of *Xestoleberis* possesses a comparably 'angular' outline to *X. hartmanni* (Fig. 56). Although the outline of the RV of *X. ramosa* is similar, the DM outline of the LV of Müller's species is broadly

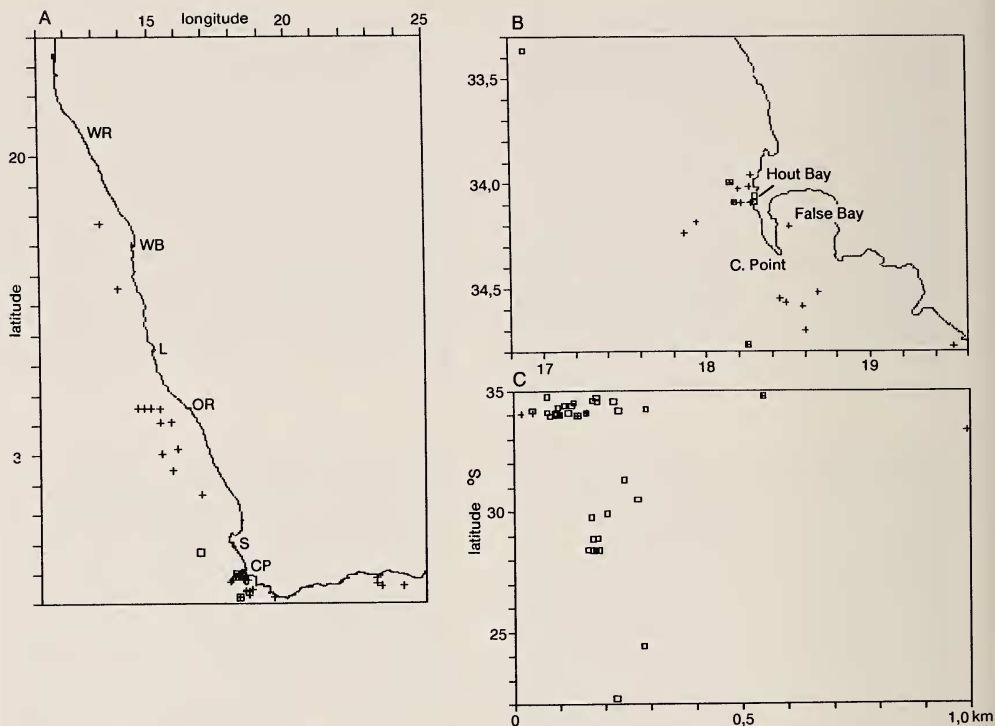


Fig. 57. A. Distribution of *Xestoleberis hartmanni* sp. nov. (squares) and *X. africana* Brady, 1880 (crosses). See Fig. 7 for abbreviations. B. Distribution of *X. hartmanni* sp. nov. (squares) and *X. africana* Brady, 1880 (crosses) off the south-western Cape. C. Latitudinal water-depth distribution of sites with *X. hartmanni* sp. nov. (crosses) and *X. africana* Brady, 1880 (squares).

rounded, and in dorsal view is more elliptical, with rounded extremities. The other continental shelf species, *X. africana*, has an overall rounded and inflated appearance and cannot be confused with *X. hartmanni*.

Distribution

Xestoleberis hartmanni is limited to the waters off the south-western Cape. One site only contains modern specimens (15 m in Hout Bay).

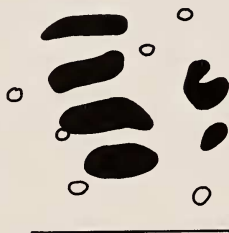


Fig. 58. *Xestoleberis hartmanni* sp. nov., SAM-PQ-MF0581, LV, MS, TBD 6825, 160 m. Scale bar = 100 microns.

Relict populations occur at three sites off the Cape Peninsula (42–160 m), and at two further isolated, much deeper locations: south-west of Saldanha (990 m), and south-west of Cape Point (545 m) (Fig. 57B). The species reaches a maximum abundance of 6 per cent total ostracod population in 160 m off the Cape Peninsula.

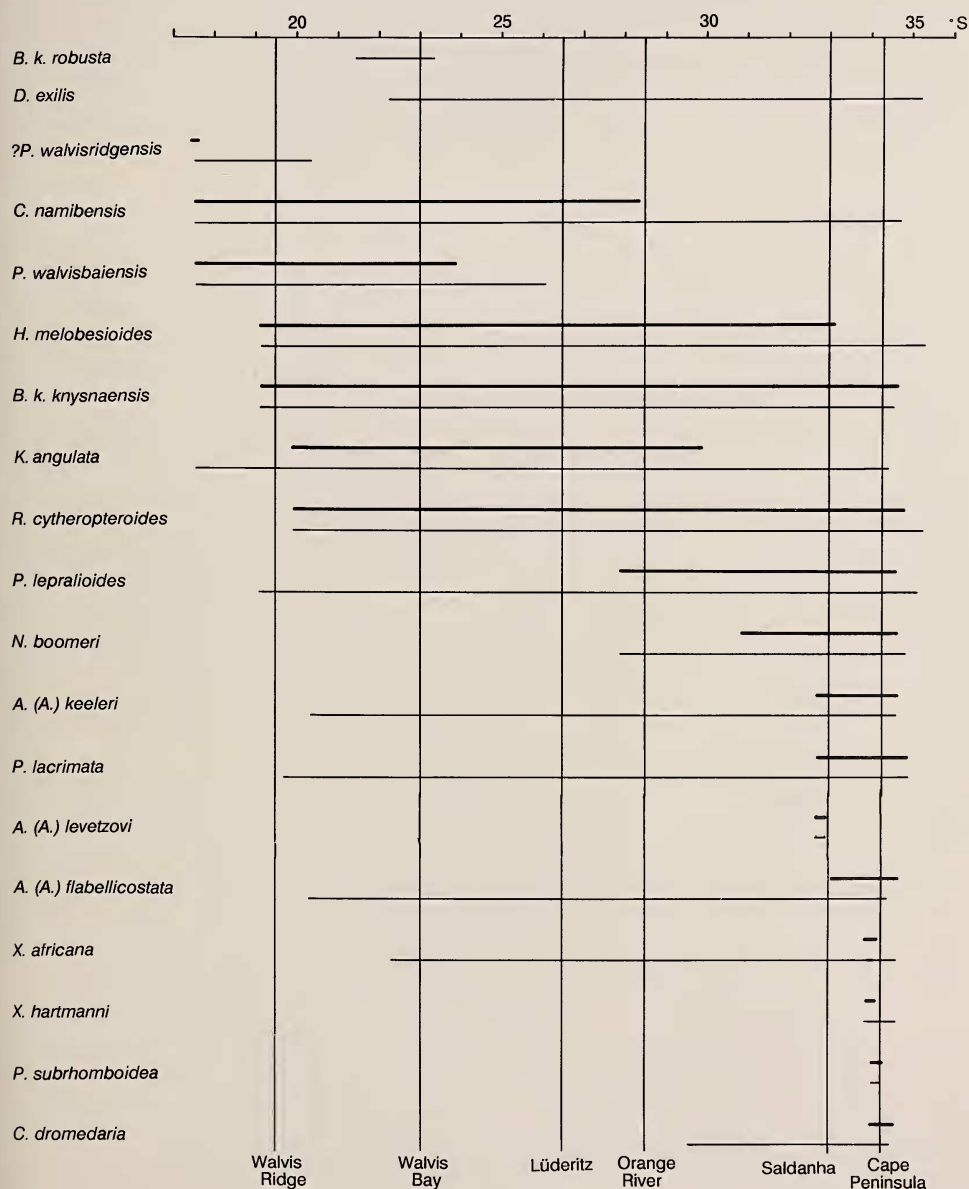


Fig. 59. Modern and relict latitudinal ranges of dominant ostracod taxa on the continental margin off south-western Africa. Thick lines = modern range, thin lines = relict range.

SUMMARY

Figures 4, 5 and 59 and Table 6 summarize the distribution of the dominant ostracod taxa on the continental margin of south-western Africa.

On a regional scale there is dominance by two groups, with an area of overlap in the Walvis Bay–Orange River zone: loxoconchids–*Cytherella*–*Bensoni* form a northern assemblage, and *R. cytheropteroides* and *P. lepralioides* dominate in the south. This regional pattern occurs in both relict and modern assemblages. *Henryhowella* is locally dominant in both northern and southern sectors.

A comprehensive discussion of the distribution of the ostracod taxa on the continental shelf off south-western Africa (both dominant and minor forms) will be given in Dingle (in press) and Dingle & Girandeau (in press).

ACKNOWLEDGEMENTS

The samples on which this study is based were collected while the author was Director of the Marine Geoscience Unit, University of Cape Town. Fellow scientists and crew of the University's then-research vessel 'Thomas B. Davie' are thanked for their dedication and endurance afloat. The following agencies funded sea-time: University of Cape Town, Geological Survey, SANCOR, and FRD. Some of the laboratory work was undertaken while the author was on sabbatical leave as Visiting Professor at University College London, and I gratefully acknowledge facilities provided by Professors M. Audley-Charles and A. R. Lord. Professor G. Hartmann (University of Hamburg) is thanked for the loan of paratypes of *Palmoconcha walvisbaiensis* (Hartmann, 1974). My colleague, Professor R. C. Whatley (University College Aberystwyth) is thanked for advice on taxonomy, and the manuscript has been improved through the constructive criticism of the following referees: Professors Whatley and A. R. Lord, and Dr H. J. Oertli (Pau, France).

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